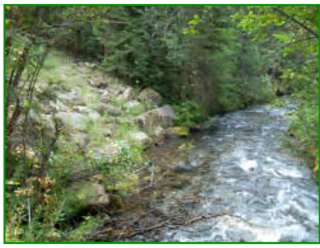


White Porcupine Multiple Timber Sale Project

Draft Environmental Impact Statement

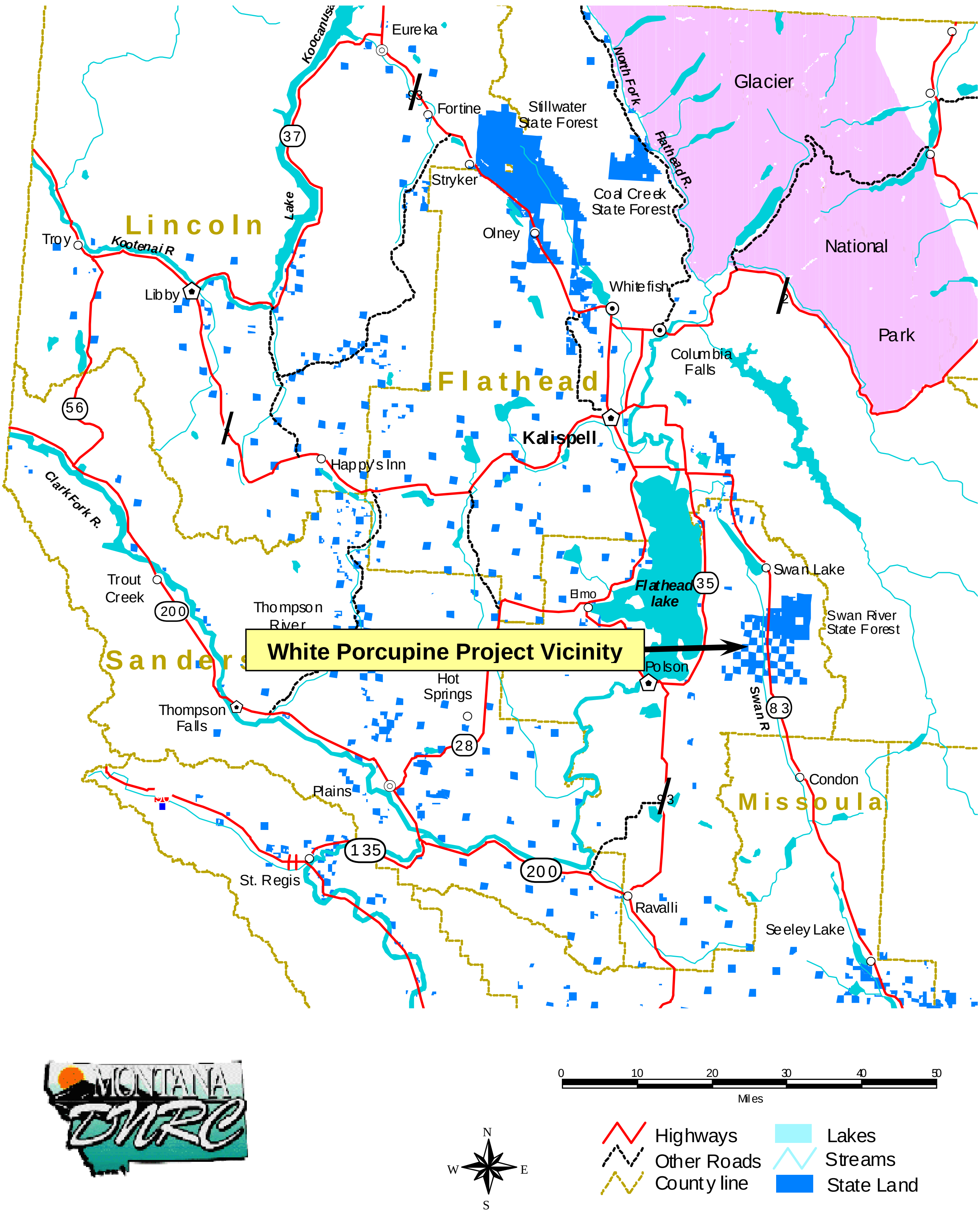
Draft Environmental Impact Statement

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

SWAN RIVER STATE FOREST

AUGUST 2008

White Porcupine Multiple Timber Sale Project Vicinity Map



DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

BRIAN SCHWEITZER, GOVERNOR

STATE OF MONTANA

NORTHWESTERN LAND OFFICE
2250 HIGHWAY 93 NORTH
KALISPELL, MT 59901-2557

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FAX: (406) 751-2288

August 22, 2008

WHITE PORCUPINE MULTIPLE TIMBER SALE PROJECT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Enclosed is a copy of the White Porcupine Multiple Timber Sale Project Draft Environmental Impact Statement (DEIS). I encourage you to carefully review the information presented in the DEIS and provide comments to Kristen Baker, Project Leader, Swan River State Forest, 34925 MT Highway 83, Swan Lake, Montana 59911, e-mail: kbaker@mt.gov, fax: 406-754-2884. **Comments must be received by September 23, 2008.** Along with your comments, please be sure to include your name, address, telephone number, and the title of the DEIS for which you are providing comments.

The proposed project is located approximately 7 miles south of Swan Lake, Montana in Swan River State Forest.

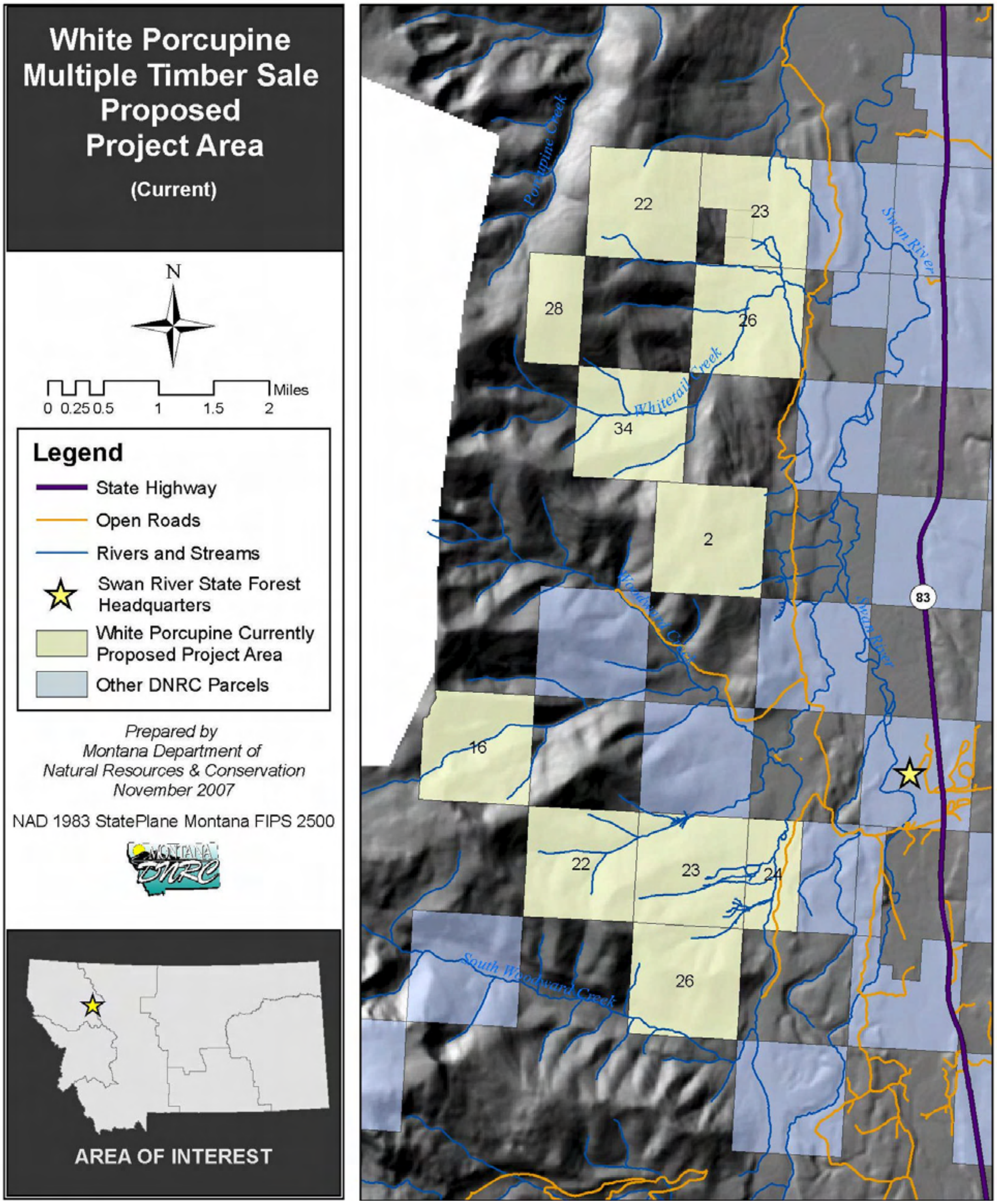
The Department does not present a preferred alternative of the three action alternatives analyzed in the DEIS. The proposed harvest volumes range from 0 with the No-Action Alternative A to between 15.5 and 24.1 MMbf with Action Alternatives B, C, and D

This DEIS was designed to address Swan River State Forest's primary commitment to Montana's mandated timber harvest levels over a three-year period. This approach analyzes cumulative effects to valuable resources and improves coordination for project planning within the active subunits as scheduled by the Swan Valley Grizzly Bear Conservation Agreement.

The Executive Summary conveys information and is written so that a person of any interest level can understand the contents. Chapter III, in the DEIS, contains the bulk of the scientific analysis. I welcome your thoughts and comments.

Sincerely

Daniel J. Roberson
Unit Manager
Swan River State Forest
34925 MT Highway 83
Swan Lake, MT 59911
(406) 754-2301


White Porcupine
Multiple Timber Sale
Proposed
Project Area
(Current)
N
0 0.25 0.5 1 1.5 2 Miles
Legend
State Highway
Open Roads
Rivers and Streams
Swan River State Forest Headquarters
White Porcupine Currently Proposed Project Area
Other DNRC Parcels
Prepared by
Montana Department of
Natural Resources & Conservation
November 2007
NAD 1983 StatePlane Montana FIPS 2500
AREA OF INTEREST
Porcupine Creek
22
23
28
26
Whitetail Creek
34
Swan River
2
Woodward Creek
83
16
22
23
24
26
South Woodward Creek

WHITE PORCUPINE MULTIPLE TIMBER SALE PROJECT
DRAFT ENVIRONMNETAL IMPACT STATEMENT
PREFACE

This document has been designed and developed to provide the decisionmaker with sufficient information to make an informed, reasoned decision concerning the proposed White Porcupine Multiple Timber Sales Project (proposed action) and to inform the interested public about this project so they may express their concerns to the Project Leader and Decisionmaker.

The DEIS consists of the following sections:

- Chapter I - Purpose and Need
- Chapter II - Alternatives
- Chapter III - Existing Environment and Environmental Effects
- Stipulations and Specifications
- References
- List of Preparers
- Scoping List and Respondents
- Glossary
- Acronyms and Abbreviations

Chapters I and II offers a summary overview of the proposed action. These chapters have been written so nontechnical readers can easily understand the purpose and need of the proposed action, alternatives to the proposed action, and the potential environmental, economic, and social effects associated with the no-action and action alternatives.

Chapter I provides a brief description of the proposed action and explains key factors about the project, such as:

1) the purpose and need of the proposed action, which includes the project objectives
2) the Environmental Impact Statement process, which includes how scoping is done and the decisions made by the decisionmaker concerning this project,
3) the proposed schedule of activities,
4) the scope of this DEIS, which includes other relevant projects, issues studied in detail, and issues eliminated from further analysis, and
5) the relevant laws, regulations, and consultations with which DNRC must comply.

CHAPTER II provides detailed descriptions of the No Action and the Action Alternatives. Included is a summary comparison of project activities associated with each alternative, a summary comparison of the predicted environmental effects of each alternative. These comparisons provide the decisionmaker a clear basis for choice between the no-action and action alternatives.

CHAPTER III briefly describes the past and current conditions of the pertinent ecological and social resources in the project area that would be meaningfully affected, establishing a part of the baseline used for the comparison of the predicted effects of the alternatives. Chapter III also presents the detailed, analytic predictions of the potential direct, indirect, and cumulative effects associated with the no-action and action alternatives.

STIPULATIONS AND SPECIFICATIONS includes a list of measures designed to prevent or reduce the potential effects to the resources considered in this DEIS.

REFERENCES lists the references utilized in the DEIS

LIST OF PREPARERS lists the preparers of the DEIS

SCOPING LIST AND RESPONDENTS lists the persons, agencies, and organizations that are listed to receive scoping documents, newsletters, and public participation activities associated with the proposed action. This list also contains those individuals who submitted issues and concerns regarding the proposed action.

GLOSSARY defines the technical terms used throughout the document

ACRONYMS AND ABBREVIATIONS lists the acronyms and abbreviations used throughout the document

TABLE OF CONTENTS

CHAPTER I
PURPOSE AND NEED

PURPOSE AND NEED

Swan River State Forest, Montana Department of Natural Resources and Conservation (DNRC), Trust Land Management Division, is proposing the White Porcupine Multiple Timber Sales Project. The proposed action is located approximately 7 air miles southwest of Swan Lake on school trust lands in the northwest portion of Swan River State Forest. The proposed project includes all or portions of Sections 2, 16, 22, 23, 24, and 26, Township 23 north (T23N), Range 18 west (R18W), and Sections 22, 23, 26, 28, and 34, T24N, R18W, comprising approximately 6,295 acres (see *VICINITY MAP* on back of front cover). These sections, along with existing and proposed roads needed to access and support the proposed activities on these sections, will herein be referred to as the project area (see *PROJECT AREA MAP* located at the front of this document).

The lands involved in the proposed action are held by the State of Montana for the support of the Common School Trust (*Enabling Act of February 22, 1889*). The Board of Land Commissioners (Land Board) and DNRC are required by law to administer these trust lands to produce the largest measure of reasonable and legitimate return over the long run for these beneficiary institutions (*1972 Montana Constitution, Article X, Section 11; Montana Code Annotated [MCA] 77-1-202*).

DNRC strives to balance fiduciary responsibilities with stewardship responsibilities that are intended to promote biodiversity and subsequently protect the future income-generating capacity of the forest. All forested lands involved in the proposed action are thus managed in accordance with DNRC's State Forest Land Management Plan (SFLMP) and Forest Management Rules (*Administrative Rules of Montana [ARM] 36.11.401 through 456*) and are subject to the following management philosophy:

"Our premise is that the best way to produce long-term income for the trust is to manage intensively for healthy and biologically diverse forests. Our understanding is that a diverse forest is a stable forest that will produce the most reliable and highest long-term revenue stream. Healthy and biologically diverse forests would provide for sustained income from both timber and a variety of other uses. They would also help maintain stable trust income in the face of uncertainty regarding future resource values. In the foreseeable, future timber management will continue to be our primary source of revenue and primary tool for achieving biodiversity objectives." (DNRC 1996a: Record of Decision [ROD] 1 and 2)

Management activities on the lands in the project area must comply with a number of

TRUST LAND MANAGEMENT DIVISION MISSION

"Our goal is to manage the State of Montana's trust land resources to produce revenue for the trust beneficiaries while considering environmental factors and protecting the future income-generating capacity of the land."

other applicable laws and rules, including the Swan Valley Grizzly Bear Conservation Agreement (SVGBCA). As a cooperator, DNRC is required to concentrate management activities into areas called Grizzly Bear Management Unit Subunits on a rotational basis. These subunits are generally open to active management for a 3-year period, followed by a rest period of at least 3 years. This rotational schedule strongly influences where DNRC concentrates its management activities on Swan River State Forest. Starting in 2009, the Porcupine/Woodward Subunit will be open to active management until 2012. During this open period, DNRC would propose 6 to 8 timber sales ranging from 0.5 to 4 million board feet (MMbf) in the subunit. Rather than analyze each sale individually, DNRC has developed this multiple timber sale Environmental Impact Statement (EIS) to assess the direct, indirect, and cumulative effects of all these proposed timber sales on pertinent resources in the Porcupine/ Woodward Subunit.

PROJECT OBJECTIVES

In order to fulfill its trust mandate and the management philosophy adopted through the SFLMP and Forest Management Rules, DNRC has developed the following project objectives:

- Promote biodiversity by moving forest stands towards historic covertype conditions and species composition.
- Improve forest health and productivity by addressing insect and disease issues.
- Meet the sustainable yield for Swan River State Forest in order to accomplish its long-term ecological objectives, to maximize long-term revenue for the Common School Trust, and support sustainable local communities.
- Develop and improve the transportation system and infrastructure for long-term management, fire suppression, and public access.
- Reduce fuel loads and wildfire hazards by decreasing ground and ladder fuels.
- Improve water quality by removing and rehabilitating sediment point sources, and meet Best Management Practice (BMPs) on all project roads, including haul routes to Highway 83.

DESCRIPTION OF PROPOSED ACTION

DNRC has developed 3 action alternatives designed to meet the proposed project objectives to varying degrees (see *CHAPTER II – ALTERNATIVES*). Under the action alternatives, DNRC proposes to:

- Harvest 15.5 to 24.2 MMbf from 1,186 to 1,563 acres of school trust land in order to return forest stands to more historic conditions, address moderate to high levels of insect and disease mortality, and reduce increasing fuel loads and the subsequent fire hazard in forested stands throughout the project area.
- Generate approximately $1,148,446 to $1,949,598 for the Common School Trust.
- Improve long-term management access by incrementally developing a gravel pit within a rock source that encompasses 22 acres in Section 24, T23N, R18W, constructing 9.5 to 14 miles of new roads, and improving 41.6 to 62.9 miles of existing roads to meet BMPs.
- Rehabilitate 3 to 4 existing stream-crossing sites along Woodward and Whitetail creeks and install 2 to 14 new stream crossings in

Sections 2, 15, 16, 22, 23, and 26, T23N, R18W, and 6 to 9 new stream crossings in Sections 22, 23, 26, 28, and 34, T24N, R18W.

ENVIRONMENTAL IMPACT STATEMENT PROCESS

This section describes the process by which the Interdisciplinary Team (ID Team) developed this EIS. This EIS and its related process were developed in compliance with the *Montana Environmental Policy Act* (*MEPA*); *MCA 75-1-101 through 75-1-324*, and *DNRC Procedural Rules (ARM 36.2.521 through 543*). For more information regarding these regulations, see *RELEVANT AGREEMENTS, LAWS, PLANS, PERMITS, LICENSES, AND OTHER REQUIREMENTS* further on in this chapter.

SCOPING AND PUBLIC INVOLVEMENT

Scoping, field tours, newsletters, an open house, and a community meeting account for the processes by which DNRC invited interested individuals, agencies, and organizations to identify issues and concerns associated with this proposed action.

Initial Proposal Scoping

Public scoping occurs in the initial stages of the EIS process and is used to inform interested parties that DNRC is proposing an action. The public is invited to submit issues or concerns related to the proposed action (*ARM 36.2.526*).

In June 2007, DNRC solicited public comment through the distribution of the White Porcupine Multiple Timber Sales Initial Proposal. Public notices were placed in the *Bigfork Eagle*, Kalispell's *Daily Inter Lake*, and the Swan Valley's *Pathfinder* newspapers. The proposal was mailed to individuals, agencies, internal DNRC staff, industry representatives, and other organizations that had expressed interest in Swan River State Forest management activities (see *SCOPING LIST AND RESPONDENTS*). The mailing included the objectives of the proposal, maps of the proposed project area, and contact information. During the 30-day comment period, a total of 21 responses were received.

Field Tours and Open House

Fall 2007

DNRC hosted a field tour on September 10, 2007. DNRC staff members and 7 participants visited stands in and adjacent to the proposed harvest units. Questions and concerns were recorded and cross-referenced with comments received during the initial proposal scoping period to ensure that pertinent issues were captured.

Spring 2008

DNRC hosted an open house on April 9, 2008; 8 people attended. DNRC updated participants on the project development, described the proposed action alternatives, shared the most current project timeline, answered questions, and provided opportunity for participants to comment on the proposed action. Again, questions and concerns were recorded and cross-referenced with comments received previously to ensure all concerns were captured.

Summer 2008

DNRC presented the proposed project 21 members of the public at the Swan Lake Community Club on June 23, 2008. The presentation closely followed the April 9 open house.

On July 7, 2008, DNRC held a second field tour. Nine participants and DNRC staff visited sediment point source sites, stands in proposed harvesting units, and other areas of interest to participants to provide project information and solicit any remaining comments or concerns. Questions and concerns were recorded and cross-referenced with comments received from previous public involvement to ensure that pertinent issues were captured.

Newsletters

Newsletter 1

On December 7, 2007, the ID Team sent a newsletter to individuals/groups on the scoping list. The purpose of this newsletter was to:

- update the project development since the initial proposal scoping period;
- introduce the ID Team and decisionmaker to the public;
- summarize relevant issues identified up to that point;
- invite comments on the proposed action; and
- solicit interest in on-site field tours of the proposed project area.

No comments or requests for field tours were received.

Newsletter 2

On March 3, 2008, the ID Team sent a second newsletter out to individuals/groups on the scoping list to:

- update the project development since the first newsletter;
- summarize the proposed action alternatives;
- invite comments on the proposed action and alternatives;
- give information on the open house scheduled for April 9, 2008; and
- request preferred dates for future tours of the proposed project area.

Two written comments and 1 request to be informed when the environmental documents were published were received.

ISSUE AND ALTERNATIVE DEVELOPMENT

After reviewing the responses received during the scoping period and the other public participation events, the ID Team identified more than 110 issues related to the project (see *ISSUES STUDIED IN DETAIL AND ISSUES ELIMINATED FROM FURTHER ANALYSIS* under *SCOPE OF THIS EIS* later in this chapter). These issues along with issues raised by the DNRC staff, field work, and requirements imposed by applicable rules, laws, and regulations all provided the framework by which the ID Team developed a reasonable range of alternatives. The ID Team designed all action alternatives to meet the project objectives to varying degrees while considering and analyzing for direct, indirect, and cumulative effects on pertinent resources in the project area.

DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

During winter through early summer of 2008, the ID Team developed this DEIS. Issues received from the public and internal agency staff drove the analyses for the various resources. Upon publication, a letter of notification will be sent to individuals on the scoping list (*SCOPING LIST AND RESPONDENTS*). The Executive Summary and/or the DEIS will be circulated to individuals, agencies, and organizations requesting copies of these documents. This DEIS will also be placed on the DNRC website (http://dnrc.mt.gov/env_docs/). Comments to the DEIS will be accepted for 30 days following publication (September 22, 2008).

FINAL ENVIRONMENTAL IMPACT STATEMENT (FEIS)

After public comments are received, compiled, and addressed, DNRC will prepare an FEIS or adopt the DEIS as the FEIS. The FEIS would consist primarily of a revision of the DEIS that would incorporate new information based on public and internal comments. The FEIS would also include responses to substantive comments within the scope of the project received during the 30-day public review period of the DEIS.

NOTIFICATION OF DECISION

Following publication of the FEIS, the decisionmaker will review public comments, the FEIS, and information contained in the project file. No sooner than 15 days after the publication of the FEIS, the decisionmaker will consider and determine the following:

- Do the alternatives presented in the FEIS meet the project's purpose and objectives?
- Are the proposed mitigations adequate and feasible?
- Which alternative (or combination/ modification of alternatives) should be implemented and why?

These determinations will be published and all interested parties will be notified. The decisions presented in the published document will become recommendations from DNRC to the Land Board. Ultimately the Land Board will make the final decision to approve or not approve the project.

PROPOSED SCHEDULE OF ACTIVITIES

After the decision is published, and if an action alternative is selected, DNRC would prepare 6 to 8 sales from 0.5 to 4 MMbf each, approximately, over the 3-year operating period. The first timber sale contract package would tentatively be scheduled for presentation to the Land Board in December 2008. If the Land Board approves the timber sale, the sale may be advertised that winter. The other contracts would subsequently be presented to the Land Board; upon approval these sales would be advertised intermittently from the spring of 2009 through the winter of 2011. After each sale is sold, harvesting and roadwork activities would occur for 2 to 3 years. The anticipated end date of harvesting activities is February 2012. Posttreatment activities, such as site preparation, planting, and hazard reduction, would follow harvesting activities.

SCOPE OF THIS EIS

This section describes those factors that went into determining the scope (depth and breadth) of this environmental analysis.

RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS

In order to adequately address the cumulative effects of the proposed action on pertinent resources, each analyst must account for the effects of past, present, and reasonably foreseeable actions within a determined analysis area. The locations and sizes of the analysis areas vary by resource (watershed, soils, etc.) and species (bull trout, grizzly bear, etc.) and are further described by resource in *CHAPTER III – EXISTING ENVIRONMENT AND ENVIRONMENTAL EFFECTS.*

Past, present, and reasonably foreseeable actions on DNRC-managed lands and adjacent land ownerships were considered for each analysis conducted for this EIS. DNRC often lacked data regarding actions on adjacent land ownerships; therefore, resource specialists were limited to qualitatively describing and considering, rather than quantifying, such actions for cumulative effects.

The following list encompasses other relevant DNRC actions considered in this DEIS:

- Goat Squeezer Timber Sales I, II, and III (2003 through 2006)
  - 1,866 acres
  - Sections 32, 33, and 34, T24N, R 17W; and Sections 8, 9, 10, 16, 22, 26, 28, 31, 32, and 34, T 23N, R17W
  - 10.2 MMbf
- Lucky Logger Salvage Project (Summer/ Winter 2007)
  - 80 acres
  - Section 12, T23N, R18W
  - 47 Mbf
- Three Creeks Timber Sale Project (Summer 2007 through Winter 2009)
  - 1,884 acres
  - Sections 1, 3, 4, 9, 10, 15, 16, 22, 25 and 27, T24 N, R18W
  - 23.7 MMbf
- Low Wood Salvage Project (ongoing to Summer 2008)
  - 60 acres
  - Sections 12 and 14, T23N, R18W
  - 100 Mbf
- Winter Blowdown Salvage Timber Permit Project (ongoing to Summer 2008)
  - 240 acres
  - Sections 16, 20, 30, 32, and 34, T23N, R17W
  - 200 Mbf
- Section 28 Salvage Permit (Summer/ Winter 2008)
  - 80 acres
  - Section 28, T23N, R18W
  - 100 Mbf
- South Woodward Timber Sale Project (2002 through 2004)
  - 514 acres
  - Sections 10, 22, 24, 26, and 28, T23N, R18W
  - 4.5 MMbf
- Main Wood 10 Salvage Permit (Winter 2008)
  - 50 acres
  - Section 10, T23N, R18W
  - 25 Mbf
- Woodward Pointed Face Precommercial Thinning Project (Summer/Fall 2009)
  - 176 acres
  - Sections 2 and 12, T23N, R18W and Section 34, T24N, R18W
- Goat Subunit (2012 through 2014) - sections and volume unknown

ISSUES STUDIED IN DETAIL AND ELIMINATED FROM FURTHER ANALYSIS

As indicated in *ISSUE AND ALTERNATIVE DEVELOPMENT* under *ENVIRONMENTAL IMPACT STATEMENT PROCESS* in this chapter, the ID Team identified over 110 issues raised internally and by the public. Issues pertain to statements that raise concern about the potential impacts the project may have on various resources. The ID Team determined which issues would be analyzed in detail and which would be eliminated from further analysis. Issues to be analyzed in detail were determined to be relevant and within the scope of the project. These were included in the impacts analyses and used to assist the ID Team in developing a reasonable range of alternatives (*TABLE I - 1 – ISSUES STUDIED IN DETAIL*). Issues that were eliminated from further analysis were those that were determined to not be pertinent to the development of alternatives or were beyond the scope of the project, and were, therefore, not carried through the impacts analyses (*TABLE I–2 – ISSUES ELIMINATED*).

TABLE I–1 – ISSUES STUDIED IN DETAIL*. *Issues studied in detail by resource area and where addressed in EIS.

ISSUE STUDIED IN DETAIL	WHERE ADDRESSED IN DEIS
VEGETATION	
The proposed activities may affect the forest covertypes through species removal or species composition change.	Chapter III, pages 7 through 15
The proposed activities may affect age classes through tree removal.	Chapter III, pages 16 through 27
The proposed activities may affect old-growth amounts and quality through tree removal.	Chapter III, pages 27 through 45
The proposed activities may affect patch size and shape through tree removal.	Chapter III, pages 46 through 52
The proposed activities may affect fragmentation through tree removal.	Chapter III, pages 52 through 54
The proposed activities may affect stand vigor through tree removal.	Chapter III, pages 54 through 57
The proposed activities may affect stand structure through tree removal.	Chapter III, pages 57 through 61
The proposed activities may affect crown cover through tree removal.	Chapter III, pages 61 through 64
The proposed activities may affect insect and disease levels through tree removal (both suppressed/stressed and infested/infected).	Chapter III, pages 64 through 75
The proposed activities may affect forest fire conditions, levels, and hazards through tree removal, increased public access, and/or fuel reduction.	Chapter III, pages 75 through 79
The proposed activities may affect sensitive plant populations through ground disturbance.	Chapter III, pages 79 and 80
The proposed activities may affect noxious weed populations and presence through ground disturbance and weed introduction.	Chapter III, pages 80 and 81
WATERSHED AND HYDROLOGY	
Timber harvesting and related activities, such as road construction, can lead to water-quality impacts by increasing the production and delivery of fine sediment to streams.	Chapter III, pages 92 through 102
Timber harvesting and associated activities can affect the timing, distribution, and amount of water yield in a harvested watershed.	Chapter III, pages 102 through 110
FISHERIES	
The proposed actions may affect fisheries populations.	Chapter III, pages 126 through 175
The proposed actions may affect the fisheries habitat feature of flow regime.	Chapter III, pages 126 through 175

ISSUE STUDIED IN DETAIL	WHERE ADDRESSED IN DEIS
The proposed actions may affect the fisheries habitat feature of sediment.	Chapter III, pages 126 through 175
The proposed actions may affect the fisheries habitat feature of channel forms.	Chapter III, pages 126 through 175
The proposed actions may affect the fisheries habitat feature of riparian condition.	Chapter III, pages 126 through 175
The proposed actions may affect the fisheries habitat feature of large woody debris.	Chapter III, pages 126 through 175
The proposed actions may affect the fisheries habitat feature of macroinvertebrate richness.	Chapter III, pages 126 through 175
The proposed actions may affect the fisheries habitat feature of connectivity.	Chapter III, pages 126 through 175
The proposed actions may have cumulative effects to fisheries resources.	Chapter III, pages 126 through 175
WILDLIFE	
The proposed activities could result in changes in the distribution of different covertypes on the landscape, which could affect wildlife.	Chapter III, pages 177 through 180
The proposed activities could alter the representation of stand-age classes on the landscape, which could affect wildlife.	Chapter III, pages 180 and 181
The proposed activities could affect wildlife species associated with old-growth forests.	Chapter III, pages 182 through 186
The proposed activities could result in disturbance or alteration of forested corridors and connectivity, which could inhibit wildlife movements.	Chapter III, pages 186 through 191
The proposed activities could reduce forested cover which could adversely affect habitat linkage for wildlife.	Chapter III, pages 191 through 195
The proposed activities could result in changes in patch size and shape and cause fragmentation of interior forest habitat.	Chapter III, pages 195 through 199
The proposed activities could reduce the number and distribution of snags, which could adversely affect species closely associated with these habitat attributes.	Chapter III, pages 199 through 205
The proposed activities could reduce levels of coarse woody debris, which could adversely affect species closely associated with these habitat attributes.	Chapter III, pages 205 through 209
The proposed activities could result in the alteration of suitable lynx denning and foraging habitats, rendering them unsuitable for supporting lynx.	Chapter III, pages 209 through 220
The proposed activities could result in disturbance of wolves at denning or rendezvous sites, which could lead to pup abandonment and/or increased risk of mortality.	Chapter III, pages 220 through 232
The proposed activities could result in reduced habitat quality on winter range for white-tailed deer and elk, which could lead to reduced prey availability and reduce the potential for the area to support a wolf pack.	Chapter III, pages 220 through 232

ISSUE STUDIED IN DETAIL	WHERE ADDRESSED IN DEIS
The proposed activities could result in increased human disturbance and potential for wolf-human conflicts that could alter wolf use of suitable habitats.	Chapter III, pages 220 through 232
The proposed activities could result in the reduction of hiding cover important for grizzly bears, which could result in increased displacement of grizzly bears, avoidance of otherwise suitable habitat, and/or increased risk of bear-human conflicts.	Chapter III, pages 232 through 244
The proposed activities could result in an increase in road density, which could result in increased displacement of grizzly bears and increased risk of bear-human conflicts.	Chapter III, pages 232 through 244
The proposed activities could result in a decrease in secure areas for grizzly bears, which could result in increased displacement of grizzly bears.	Chapter III, pages 232 through 244
The proposed activities could reduce the amount and/or quality of fisher habitats, which could alter fisher use of the area.	Chapter III, pages 244 through 253
The proposed activities could reduce suitable nesting and foraging habitat for pileated woodpeckers, which could alter pileated woodpecker use of the area.	Chapter III, pages 253 through 260
The proposed activities could remove forest cover on important winter ranges, which could lower their capacity to support white-tailed deer and elk.	Chapter III, pages 260 through 268
The proposed activities could remove elk security cover, which could affect hunter opportunity and the local quality of recreational hunting.	Chapter III, pages 260 through 268
GEOLOGY AND SOILS	
Traditional ground-based harvesting operations have the potential to compact and displace surface soils, which reduces hydrologic function, macroporosity, and soils function.	Chapter III, pages 274 through 294
Harvesting operations have the potential to increase erosion of productive surface soils off-site.	Chapter III, pages 274 through 294
Harvesting activities associated with the proposed actions may cumulatively affect long-term soil productivity.	Chapter III, pages 274 through 294
Activities associated with the proposed actions, such as timber harvesting and road construction, have the potential to affect slope stability through increased water yields and road surface drainage concentration, resulting in the exceedence of resisting forces.	Chapter III, pages 274 through 294
The removal of large volumes of both coarse and fine woody material through timber harvesting reduces the amount of organic matter and nutrients available for nutrient cycling, possibly affecting the long-term productivity of the site.	Chapter III, pages 274 through 294
ECONOMICS	
The proposed action may affect revenue generated for the Common School Trust, funding for forest improvement projects, timber-related employment, and revenue generated in the regional economy.	Chapter III, pages 296 through 300

ISSUE STUDIED IN DETAIL	WHERE ADDRESSED IN DEIS
AIR QUALITY	
Smoke produced from prescribed burning associated with the proposed action may adversely affect local air quality.	Chapter III, pages 302 through 305
Dust produced from road construction, road maintenance, harvest-related traffic, and gravel pit development and operations associated with the proposed action may adversely affect local air quality.	Chapter III, pages 302 through 305
RECREATION	
Activities associated with the proposed action may affect recreational uses in the area and the subsequent revenue generated by such uses. The recreational uses of particular concern include public motorized use, hunting, and other public non-motorized uses.	Chapter III, pages 308 through 312
AESTHETICS	
Activities associated with the proposed action may affect the visual quality as seen from specific observation points in the project area.	Chapter III, pages 314 through 330
Activities associated with the proposed action may affect local noise levels.	Chapter III, pages 316 through 321

TABLE I–2 – ISSUES ELIMINATED. Issues eliminated from further analysis and accompanying rationale.

ISSUE ELIMINATED FROM FURTHER ANALYSIS	**RATIONALE**
Stream buffers of 25 feet are not adequate to protect stream sediment, temperature and complexity.	Any riparian timber harvesting conducted on State trust lands adjacent to fish-bearing streams must implement the Streamside Management Zone Law (SMZ) and Rules and Forest Management Rules that apply to riparian management zones, which include buffers with a minimum width of 50 feet.
Current and future [State timber] projects are producing lower timber yield than past projects.	No existing data or studies show that current and future projects are producing lower timber yields than past projects. Current DNRC practices are aimed at producing more growth and yield on its forested lands with each passing year. Greater yield and growth will occur as older slower-growing stands are replaced by younger faster-growing stands and additional acres are planted and thinned.
Data and modeled results in the analysis may not adequately disclose the range of effects and statistical uncertainty.	DNRC utilizes the best available information in this DEIS, by considering a reasonable depth of analysis, time constraints, and limited resources. Models are imperfect tools; therefore, efforts have been made in each analysis subsection to identify relevant points of uncertainty.
DNRC does not have an incidental take permit for bull trout [or other species] and has not completed a Habitat Conservation Plan.	Although DNRC is in the process of completing a Habitat Conservation Plan for an incidental take permit for bull trout and other species, the lack of either does not preclude DNRC from conducting timber-management activities.
DNRC does not have conservation strategies for sensitive species, wolves, and bald eagles.	DNRC currently manages habitat for these species under the fine-filter approach and has Forest Management Rules that address sensitive species, wolves, and bald eagles. Following adoption of the Habitat Conservation Plan, DNRC would continue to manage for the needs of any threatened and endangered species not included for Habitat Conservation Plan coverage and apply appropriate protective measures through implementation of Forest Management Rules designed to minimize risk to the species.
DNRC is failing to monitor the effectiveness of noxious weed treatments.	See *NOXIOUS WEEDS* in the *VEGETATION ANALYSIS* in *CHAPTER III – EXISTING ENVIRONMENT AND ENVIRONMENTAL EFFECTS,* to see how weed concerns will be addressed in this project.
DNRC is not adequately disclosing and analyzing the long-term costs associated with the treatment of noxious weeds.	DNRC monitors and sprays noxious weeds through utilization of Forest Improvement (FI) funds collected as a fee separate from stumpage during harvesting activities. See *NOXIOUS WEEDS* in the *VEGETATION ANALYSIS* in *CHAPTER III – EXISTING ENVIRONMENT AND ENVIRONMENTAL EFFECTS* to see how weed concerns will be addressed in this project.

ISSUE ELIMINATED FROM FURTHER ANALYSIS	RATIONALE
DNRC is not successfully replanting and regrowing stands on Swan River State Forest.	As specified in *ARM 36.11.420*, DNRC is required to monitor the effectiveness of completed silvicultural treatments at meeting treatment objectives. To that end, *ARM 36.11.420* requires DNRC to promptly complete a regeneration survey in all stands where regeneration cutting has been applied. In planted stands, DNRC is required to complete a survival survey in the first fall following planting. If regeneration or survival surveys indicate that postharvest stands fail to meet regeneration or adequate stocking levels, measures such as additional planting may occur as deemed financially and ecologically feasible. Nonstocked stands historically occurred on the landscape and Swan River State Forest (at 3 percent) currently falls far below the historical average of 12 percent.
DNRC should consult with US Fish and Wildlife Service (USFWS) concerning how the project will affect grizzly bears, wolves, lynx, and bull trout.	DNRC has the obligation to not "take" threatened or endangered species under section 9 of the *Endangered Species Act*. Thus, DNRC minimizes risk to these species by applying Forest Management Rules designed to address important risk factors and habitat needs. Under section 9 of the Act, state agencies are not required to formally consult with USFWS.
DNRC should have a more educational focus rather than such a strong emphasis on timber extraction.	DNRC's role, as established under the *Enabling Act*, is that of a trust guardian with the responsibility to generate the largest measure of reasonable and legitimate revenue to trust beneficiaries while protecting the revenue-generating capacity of State trust lands for future generations. Following the philosophy of the SFLMP and the requirements of Forest Management Rules helps ensure that DNRC operates responsibly and with appropriate attention to necessary fiduciary and stewardship obligations.
DNRC will not adequately consider public concerns and issues during the MEPA process.	Since the initial scoping period, DNRC has kept a working list of issues raised by the public through emails, letters, field tours, and public meetings. This list of issues assisted each specialist in developing formal issue statements that were carried through the DEIS in detailed analysis. DNRC appreciates the time and effort that goes into submitting comments on projects such as these and is committed to carefully considering each issue raised internally and by the public. *ISSUES STUDIED IN DETAIL AND ELIMINATED FROM FURTHER ANALYSIS* under *SCOPE OF THIS EIS* earlier in this chapter further explains how your issues were considered throughout the MEPA process.

ISSUE ELIMINATED FROM FURTHER ANALYSIS	RATIONALE
DNRC will not apply the MEPA process appropriately.	DNRC is committed to following all steps of the MEPA process to ensure that adequate consideration is given to issues raised internally and by the public and that appropriate analyses are conducted to determine the potential impacts the proposed action may have on pertinent resources. The appropriate analysis for each subsection of the DEIS is determined by each resource specialist and is carried forth in *CHAPTER III – EXISTING ENVIRONMENT AND ENVIRONMENTAL EFFECTS.*
Project activities may adversely modify critical bull trout habitat on Woodward Creek.	Any potential adverse impacts of the proposed actions to fisheries habitat in Woodward Creek will be discussed under *FISHERIES ANALYSIS* of this DEIS. However, "critical habitat" is a designation that only applies to federal actions or actions involving a federal nexus, neither of which would occur as a result of the proposed actions. Therefore, this issue is technically eliminated from further analysis since the proposed actions do not apply.
Project activities may affect old growth by not considering a long-term plan, including longer rotations and mapping.	DNRC management decisions regarding old growth at the project level follow *ARM 36.11.418(a) and (c)*. When considering old-growth management at the project level, careful attention is given to many variables including (but not limited to): covertypes, stand locations, patch sizes, habitat connectivity, insect/disease risk, etc. DNRC must also consider the requirements of *MCA 77-5-116*, which is a law that prohibits the Department from establishing old-growth deferrals and set-asides without compensation to trust beneficiaries. For each timber sale project on Swan River State Forest, stand maps are produced and evaluated to help evaluate management priorities and trade-offs necessary for informed decisionmaking. This approach has allowed DNRC to evaluate conservation biology principles and tradeoffs at the landscape scale and have improved flexibility to address stand changes and economic losses brought about by natural-disturbance agents, such as insects, diseases, and wildfire. Old-growth stands receiving uneven-aged harvesting will be managed under a relatively long rotation with DNRC's current approach. Environmental effects on old growth are described under *OLD GROWTH* in *VEGETATION ANALYSIS* in *CHAPTER III – EXISTING ENVIRONMENT AND ENVIRONMENTAL EFFECTS*. The estimated amounts of old growth prior to this project and the amount of old growth after this project (by alternative) are also disclosed.

ISSUE ELIMINATED FROM FURTHER ANALYSIS	RATIONALE
Project analysis will not consider identified literature cited in written comments.	DNRC continues to use the best available information relevant to each analysis conducted in the DEIS and welcomes relevant information that may have been overlooked for any analysis.
Project costs (e.g. analysis, consultation, construction, travel, administration, reforestation) and benefits will not be adequately itemized in the economic analysis.	Itemized cost accounting involves many unknown variables and is conducted at the programmatic level, rather than on a project-by-project basis. In this DEIS (*see CHAPTER III – EXISTING ENVIRONMENT AND ENVIRONMENTAL EFFECTS, ECONOMICS*), project costs are estimated based on the most recent annual programmatic revenue to cost ratios. A more detailed review of programmatic costs is available in the TLMD Fiscal Year 2007 Return on Assets Report (*DNRC 2007a*) and Annual Report (*DNRC 2007b*).
The SFLMP does not provide adequate mitigations to ensure biological diversity is maintained.	Under the SFLMP philosophy, DNRC believes that making efforts to emulate natural disturbance patterns, processes, and covertype distributions is a reasonable and responsible way to help ensure that ecosystem processes and endemic species that evolved with them are maintained. The SFLMP also encourages managers to explore new findings and adapt management accordingly.
Timber land productivity is incorrectly calculated in the Sustained Yield Calculation.	DNRC put considerable effort into this component of the sustainable yield calculation methodology and has confidence that inputs into the model were reasonable estimates. As this issue is directly related to a separate programmatic document that was available for public comment, and which was completed in 2004, it was determined to be beyond the scope of the proposed action and was thus eliminated from further analysis.
The existing road network is too large.	When planning transportation systems, DNRC is instructed to plan for the minimum number of road miles [*ARM 36.11.421(1)*]. DNRC occasionally needs to construct additional roads in order to access timber stands for management. It would be cost prohibitive to obliterate all historical roads on the landscape. If a historical road is causing resource damage, it is prioritized for corrective actions to lessen or eliminate its negative impacts. The 3 action alternatives in this DEIS contain different projected road amounts by alternative (see *CHAPTER II − ALTERNATIVES, DESCRIPTION OF ALTERNATIVES*). Action Alternatives C and D attempt to minimize proposed road construction mileages.
Unsuitable lands, such as road prisms and deferred forest polygons, should not be included in the Swan River State Forest timber base.	This issue pertains to the analysis methodology for sustainable yield calculations involving Swan River State Forest. When the sustainable yield was calculated acres were removed from the timber base for road clearing widths, deferred forest polygons, and forest land that was designated for other uses that excluded timber management. This issue is directly related to a separate programmatic document that was available for public comment, which was completed in 2004, thus, it was determined to be beyond the scope of the proposed action and was eliminated from further analysis.

ISSUE ELIMINATED FROM FURTHER ANALYSIS	RATIONALE
Roads associated with the project may take lands out of timber production.	See *GEOLOGY AND SOILS* in *CHAPTER III – EXISTING ENVIRONMENT AND ENVIRONMENTAL EFFECTS,* in the DEIS to see how the road acreages and the effect on soil productivity, and therefore, timber production will be addressed in this project. The project implements and is within the intent of the Forest Management Rules (*ARM 36.11.421: Road Management*).
Timber sales associated with this project may not be made small enough or economically accessible for small and mid-size companies to feasibly bid on them.	Under the proposed action, DNRC would propose 6 to 8 timber sales ranging from 0.5 to 4 MMbf. The wide range of sale volumes and number of sales would provide multiple opportunities for companies of all sizes to feasibly bid on them.
Activities associated with this project in addition to influences of broad climate change may exacerbate impacts to ecosystem functions, forest vegetation, wildlife habitat, and aquatic resources.	Evidence of widespread climate change has been well-documented and reported (*Intergovernmetal Panel on Climate Change 2001 and 2007*). Within Montana forests over time, changes in tree species, their geographic distribution, and observed decline in health and productivity may be expected (*EPA 1997*). Given possible changes in the amounts and types of trees and other plants observed in forests, unique vegetation community associations and new climax community types may also begin to appear in the future (*Fox 2007*). Forest managers are just beginning to understand implications of broad-scale climate change. Understanding changes in tree species composition in forests and the ability of various tree species to thrive under changing climate conditions may take decades. Predicting possible effects of climate change in forests at local levels is also difficult due to large-scale variables at play, such as possible increases in global evaporation rates and possible changes in global ocean currents and the jet stream. Such outcomes could influence locally observed precipitation amounts, possible changes in seasons when local precipitation accumulates, and possible influences on natural disturbance regimes (such as changing the average intensity, frequency, and scale of fire events). Normal year to year variation in weather also confounds the ability to identify, understand, predict, and respond to influences of climate change. Given the many variables and difficulty in understanding the ramifications of changing climate, detailed assessment of possible direct, indirect, or cumulative effects of climate change in association with project activities described in this DEIS is beyond the scope of this analysis. In the face of current uncertainty associated with climate change, DNRC is continuing to manage for biodiversity as guided under the SFLMP. Under the management philosophy of the SFLMP, DNRC will continue to manage for desired future conditions as understood from a historical perspective (*Losensky 1997*), while working to understand relevant ecosystem changes as research findings and changes in climate evolve.

ISSUE ELIMINATED FROM FURTHER ANALYSIS	RATIONALE
Timber sales associated with this project may consist of few large projects that may be tied up in litigation rather than many smaller projects that are less controversial and that have a better chance of success.	DNRC would propose 6 to 8 timber sales ranging from 0.5 to 4 MMbf under a single Environmental Impact Statement (EIS), thus, perceived as a large project in order to better quantify the effects of the proposed activities.
DNRC should mitigate for actions on adjacent land ownerships.	DNRC may not necessarily maintain forest conditions made rare on adjacent lands by the management activities of others in amounts sufficient to compensate for their loss when assessed over the broader landscape, except as it coincides with other agency objectives [*ARM 36.11.407(3)*]. In cases where unique or rare habitats [*ARM 36.11.403 (89)*] occur on State trust lands, DNRC would manage to retain those elements to the extent practicable and consistent with its fiduciary responsibilities to the trust beneficiaries [*ARM 36.11.407(3)(a)*].
Timber harvesting activities may affect existing cultural resources on Swan River State Forest.	DNRC's archaeologist was contacted to determine if the proposed action would potentially impact any known cultural resources in the project area. In his response he indicated that there are no known cultural resources in the area.
DNRC should consider possible future ownership of current Plum Creek ownership under the Forest Legacy Project in the MEPA analysis.	Given the current status of the Forest Legacy Project, DNRC cannot determine what amount, if any, Plum Creek ownership would be purchased as Swan River State Forest trust lands in the future. Therefore, the analysis involving the inclusion of those lands as part of DNRC's managed lands would not be prudent at this time do to lack of conclusive knowledge.

RELEVANT AGREEMENTS, LAWS, PLANS, PERMITS, LICENSES, AND OTHER REQUIREMENTS

Management activities on the lands in the proposed project area must comply with the following agreements, laws, plans, permits, licenses, and other requirements.

ENABLING ACT (1889) AND 1972 MONTANA CONSTITUTION

By the Enabling Act approved February 22, 1889, the United States Congress granted certain lands to the State of Montana for the support of common schools and other public institutions. These lands are held in trust for the specific trust beneficiaries to which they were assigned and ultimately for the people of the State of Montana (*1972 Montana Constitution Article X, Section 11*). The lands involved in the proposed project area are designated to generate revenue for the Common School Trust. The Land Board and DNRC are required by law to administer these lands to produce the largest measure of reasonable and legitimate return over the long run for this beneficiary institution (*MCA 77-1-202*).

STATE FOREST LAND MANAGEMENT PLAN

DNRC developed the SFLMP to "provide field personnel with consistent policy, direction, and guidance for the management of state forested lands" (*DNRC 1996b: Executive Summary*). The SFLMP provides the philosophical basis, technical rationale, and direction for DNRC's forest-management program. The SFLMP is premised on the philosophy that the best way to produce long-term income for the trust is to manage intensively for healthy and biologically diverse forests. In the foreseeable future, timber management will continue to be the primary source of revenue and primary tool for achieving biodiversity objectives on Swan River State Forest and other DNRC-managed forested trust lands.

DNRC FOREST MANAGEMENT RULES

DNRC's Forest Management Rules (*ARM 36.11.401 through 456*) are the specific legal resource management standards and measures under which DNRC implements the SFLMP and subsequently its forest-management program. The Forest Management Rules were adopted in March 2003 and provide the legal framework for DNRC project-level decisions and provide field personnel with consistent policy and direction for managing Swan River State Forest and other state forested lands. Project design considerations and mitigations developed for this project must comply with the Forest Management Rules.

SUSTAINABLE YIELD CALCULATION

In addition to the SFLMP and Forest Management Rules, DNRC is required to recalculate the annual sustainable yield for forested trust lands at least every 10 years (*MCA 77-5-221 through 223*). DNRC defines the annual Sustainable Yield Calculation as:

> *"….the quantity of timber that can be harvested from forested state lands each year in accordance with all applicable state and federal laws, including but not limited to the laws pertaining to wildlife, recreation and maintenance of watersheds and in compliance with water quality standards that protect fisheries and aquatic life and that are adopted under the provisions of Title 75, Chapter 5, taking into account the ability of state forests to generate replacement tree growth (MCA 77-5-221)."*

The Sustainable Yield Calculation determines the amount of timber that can be harvested annually on a sustainable basis from State trust lands, given all applicable laws and environmental commitments described in the SFLMP and Forest Management Rules. Important ecological commitments related to biodiversity, forest health, threatened and endangered species, riparian buffers, old growth, and desired species mix and covertypes were incorporated into the Sustainable Yield Calculation . After incorporating these commitments into the model, the state-wide annual sustainable yield was determined to be 53.2 MMbf of timber. The annual portion for Swan River State Forest was determined to be 6.7 MMbf.

MONTANA ENVIRONMENTAL POLICY ACT AND DNRC PROCEDURAL RULES

MEPA (*MCA 75-1-101 through 324*) provides a public process that assures Montana's citizens that a deliberate effort is made to identify impacts before the state government decides to permit or implement an activity that could have significant impacts on the environment.

DNRC's management activities on State school trust lands are subject to the planning and environmental assessment requirements of MEPA. The statute requires DNRC and other state agencies to inform the public and other interested parties about proposed projects, the potential environmental impacts associated with proposed projects, and alternative actions that could achieve the proposed project objectives.

DNRC Procedural Rules (*ARM 36.2.521* through *543*) are specific legal requirements under which DNRC interprets and implements MEPA. DNRC is required to conform to the Procedural Rules prior to reaching a final decision on a proposed action.

SWAN VALLEY GRIZZLY BEAR CONSERVATION AGREEMENT (SVGBCA)

The SVGBCA is a cooperative agreement between the DNRC, Plum Creek, Flathead National Forest, and USFWS. The SVGBCA contains agreed-upon mitigations that are designed to reduce impacts to grizzly bears in the Swan Valley while allowing the cooperating parties to manage timber. As a cooperator, DNRC must abide by the terms and mitigations contained in the SVGBCA.

MEMORANDUM OF UNDERSTANDING AND CONSERVATION AGREEMENT FOR WESTSLOPE CUTTHROAT TROUT AND YELLOWSTONE CUTTHROAT TROUT IN MONTANA

DNRC is a signatory to this 2007 statewide cooperative agreement along with 17 other agencies and organizations. The cutthroat trout management goals of the agreement include the long-term persistence of each the subspecies across their historical ranges, maintenance of the genetic integrity and diversity of non-introgressed populations, as well as the diversity of life histories represented by remaining cutthroat trout populations, and protect the ecological, recreational, and economic values associated with each subspecies.

RESTORATION PLAN FOR BULL TROUT IN THE CLARK FORK RIVER BASIN AND KOOTENAI RIVER BASIN, MONTANA

DNRC is a signatory to this 2000 collaborative agreement along with 8 other agencies and organizations. The goal of this management plan is the application of a framework of conservation strategies designed to reverse or halt the decline of bull trout throughout western Montana. The plan includes guidance for protecting existing stable populations and specific recommendations for restoring populations that have declined.

MONTANA BEST MANAGEMENT PRACTICES

DNRC's BMPs for forestry consist of forest stewardship practices that reduce forest-management impacts to water quality and forest soils. The implementation of BMPs by DNRC is required under *ARM 36.11.422*. Key forestry BMP elements include:

- streamside management;
- road design and planning;
- timber harvesting and site preparation;
- stream-crossing design and installation;
- winter logging; and
- hazardous substances storage, handling, and application.

STREAM PRESERVATION ACT PERMIT

DFWP has jurisdiction over the management of fisheries and wildlife in the project area. A 124 Permit is required for activities that may affect the natural shape and form of any stream or its banks or tributaries.

SHORT-TERM EXEMPTION FROM MONTANA'S WATER-QUALITY STANDARDS

DEQ has jurisdiction over water-quality standards in the project area. A 3A Authorization may be required if temporary activities would introduce sediment above natural levels into streams or if DFWP deems a permit is necessary after reviewing the mitigation measures in the 124 Permit.

OPENCUT MINING PERMIT

DEQ has jurisdiction over opencut mining standards in the project area. An application stating the specifics of the gravel pit development would be completed and an EA may be required in order to obtain the permit.

MONTANA/IDAHO AIRSHED GROUP

DNRC is a member of the Montana/Idaho Airshed Group which was formed to minimize or prevent smoke impacts while using fire to accomplish land-management objectives and/or fuel hazard reduction (*Montana/Idaho Airshed Group 2006*). The Airshed Group determines the delineation of airsheds and impact zones throughout Idaho and Montana. As a member, DNRC must submit burn plans to the Smoke Monitoring Unit describing the type of burn to be conducted, the size of the burn in acres, and the location and elevation of each burn site. The Smoke Monitoring Unit provides timely restriction messages by airshed. DNRC is required to abide by those restrictions and burn only when conditions are conducive to good smoke dispersion.

AIR QUALITY MAJOR OPEN BURNING PERMIT

DEQ issues permits to entities that are classified as major open burners (*ARM 17.8.610).* DNRC is permitted to conduct prescribed wildland open burning activities in Montana that are either deliberately or naturally ignited. Planned prescribed burn descriptions must be submitted to DEQ and the Smoke Monitoring Unit of the Montana/ Idaho Airshed Group. All burns must be conducted in accordance with the major open burning permit.

COOPERATIVE ROAD MAINTENANCE

DNRC currently shares a number of reciprocal road access agreements with FNF and Plum Creek. DNRC would need to obtain additional reciprocal access and 1 temporary road use permit to sections involved in the proposed project area.

CHAPTER II
ALTERNATIVES

INTRODUCTION

This chapter describes in detail the no-action alternative and 3 action alternatives of the proposed action. This chapter will focus on the:

- development of the action alternatives;
- description of all the alternatives;
- summary comparison of project activities associated with each alternative;
- summary comparison of how each alternative achieved the proposed project objectives;
- summary comparison of the predicted environmental effects of each alternative; and
- stipulations and specifications common to all action alternatives.

DEVELOPMENT OF ALTERNATIVES

An ID Team was formed to work on the proposed action in the spring of 2007. The ID Team consisted of a project leader and resource specialists from various disciplines including fisheries, wildlife biology, hydrology, geology and soils, policy, and forestry. The role of the ID Team was to summarize issues and concerns, develop alternatives of the proposed action in the project area, and analyze the potential environmental effects of the alternatives on the human and natural environments.

The ID Team began reviewing resources in the proposed project area soon after the initial scoping period began. Field reviews were conducted and data were collected in the project area to aid in the analyses for affected resources, including vegetation, watershed and hydrology, fisheries, wildlife, geology and soils, economics, air quality, recreation, and aesthetics. Indepth quantitative and qualitative analysis of the data assisted the ID Team in assessing the existing environment for each resource and determining the potential environmental effects of each alternative on the affected resources.

Based on data collected from the field and issues received from the public and internally, the ID Team developed a range of alternatives designed to meet project objectives described in *PROJECT OBJECTIVES* in *CHAPTER I – PURPOSE AND NEED*. The action alternatives incorporate harvest unit design, prescriptions, mitigations, and road and gravel pit development activities that allow DNRC to conduct forest-management activities consistent with direction contained in the SFLMP and Forest Management Rules.

The estimated timber volume produced by each alternative are based on stand volume data obtained from the Stand Level Inventory (SLI) and other available data used in the analysis. Advertised volumes may vary from the preliminary estimated volumes due to the increased statistical accuracy of measured data obtained during sale layout. While the estimated log volume may be different, the environmental effects are based on acres treated and postharvest stand conditions.

DESCRIPTION OF ALTERNATIVES

This section describes No-Action Alternative A and Action Alternatives B, C, and D. All are considered viable alternatives for selection. *TABLE II–1 – COMPARISON OF ACTIVITIES* summarizes and compares project activities associated with each alternative.

SUMMARY DESCRIPTION OF ALTERNATIVES

- ***No-Action Alternative A***

  DNRC would not conduct timber harvesting, roadwork, or gravel pit development in the project area. Under this alternative:

  - The economic value of timber lost to insect infestations and disease infections would not be realized, and insect/disease problems would be expected to continue and potentially increase.
  - In the absence of natural or human disturbance, forest community types would likely continue to shift to those dominated by shade-tolerant tree species, further moving the proportion of stands on Swan River State Forest away from desired future conditions.
  - No new management-related risks to water quality, quantity, or fisheries would be created and no stream crossings would be installed; however, some legacy problems could go unrepaired without a source of ample funding.
  - Patches of forest cover and the connectivity of mature and old-growth forests would not be altered beyond that which would occur naturally.
  - Infrastructure improvements, such as road construction and reconstruction or gravel pit development, would not occur and road restrictions would remain the same.
  - Harvest volume that supports the Swan River State Forest contribution to the statewide DNRC sustainable yield would not be harvested or sold to generate revenue for the common schools beneficiaries.
  - No old-growth forest would be harvested and no old-growth maintenance treatments would be applied.
  - No visual changes to the existing viewshed would occur.

- ***Action Alternative B***

  Management activities and potential environmental effects would be extended over a broad geographic area that encompasses portions of 10 sections on Swan River State Forest (*FIGURE II–1 – ACTION ALTERNATIVE B*). Under this alternative:

  - Management and treatment of the most severe insect and disease issues in the project area would be prioritized.
  - Stand treatments would promote stand conversion toward desired future conditions; forest covertypes would be dominated by shade-tolerant, late successional species would be treated to promote shade-intolerant, early seral species, where appropriate.
  - Potential effects to water quality, water quantity, and fisheries habitat would be dispersed over a broad area that includes the Whitetail Creek, Woodward Creek, and South Woodward Creek watersheds.
  - Three wet and 16 dry stream crossings would be installed.

- Additional options in mitigating for wildlife connectivity would be presented.
- Long-term infrastructure and fire-suppression needs would be prioritized by constructing 14 miles of new road, improving 62.9 miles of existing road, and incrementally developing a 22-acre gravel source in Section 24, T23N, R18W.
- Approximately 21.5 MMbf would be harvested over an estimated 1,519 acres, which would contribute to the statewide DNRC sustainable yield for the next 3 years.
- Harvesting would take place within 1,146 acres of old-growth habitat, thus, removing 963 acres from the old-growth status.

➢ ***Action Alternative C***

Management activities and potential environmental effects would be concentrated over a smaller geographic area that encompasses portions of 7 sections on Swan River State Forest (*FIGURE II–2 – ACTION ALTERNATIVE C*). Under this alternative:

- Intensive, site-specific treatments of insects and diseases would be provided and maintenance treatment of additional stands would be allowed.
- Stand treatments would promote stand conversion toward desired future conditions; where appropriate, forest covertypes dominated by shade-tolerant, late successional species would be treated to promote shade-intolerant, early seral species (this alternative would retain the largest amount of stand acreage in the desired future condition by a margin of 96 acres).
- Potential effects to water quality, water quantity, and fisheries habitat would be confined to the Whitetail Creek watershed.
- Three wet and 8 dry stream crossings would be installed.
- Potential habitat fragmentation would be minimized by managing for larger patch sizes.
- The investment in developing access infrastructure and minimizing road construction and transportation costs for purchasers would be less, which would reduce project development costs (9.5 miles of new road would be constructed, 41.6 miles of existing road would be improved, and a 22-acre gravel source would be developed in Section 24, T23N, R18W).
- Approximately 24.2 MMbf would be harvested on an estimated 1,563 acres, which would contribute to the statewide DNRC sustainable yield for the next 3 years.
- Harvesting would take place within 1,219 acres of old-growth habitats, thus, removing 1,114 acres from the old-growth status.

➢ ***Action Alternative D***

Management activities would attempt to address project objectives while limiting the harvesting of old growth over a broad geographic area that encompasses portions of 7 sections on Swan River State Forest (*FIGURE II–3 – ACTION ALTERNATIVE D*). Under this alternative:

- A minor minor portion of the insect and disease issues in the project area would be treated while the effects to old-growth stand types and associated wildlife species would be minimized.

- Stand treatments would promote stand conversion toward desired future conditions and, where appropriate, forest covertypes dominated by shade-tolerant, late successional species would be treated to promote shade-intolerant, early seral species; this alternative would retain the least amount of stand acreage in the desired future condition.
- Treatments would minimize effects to less common covertypes or covertypes at the edge of their range (e.g. western hemlock).
- Five wet and 11 dry stream crossings would be installed.
- The old-growth patch size would be maintained in the Whitetail drainage portion of the project area.
- Infrastructure, haul route BMPs, and point-source sediment needs in the project area would be addressed; 11.2 miles of new road would be constructed, 60.4 miles of existing road would be improved, and a 22-acre gravel source would be incrementally developed in Section 24, T23N, R18W.
- Approximately 15.5 MMbf would be harvested from an estimated 1,186 acres, which would contribute to the statewide DNRC sustainable yield for the next 3 years.
- Harvesting would take place within 610 acres of old-growth habitats, thus, removing 610 acres from the old-growth status.

TABLE II–1 – COMPARISON OF ACTIVITIES. Summary comparison of project activities of the no-action and action alternatives.

ALTERNATIVE	VOLUME (MMbf)	TOTAL ACRES	OLD-GROWTH ACRES	SILVICULTURAL PRESCRIPTION (ACRES)	HARVEST METHOD	STREAM CROSSINGS	MILES OF ROADWORK
A	0	0	0	None	None	None	None
B	21.5	1,519	1,146 (removing 963 acres from old-growth status)	Seedtree (685) Seedtree with reserves (478) Shelterwood with reserves (71) Variable thin (285)	Tractor/ cable/ forwarder combination	3 wet installations in Sections 16 and 26, T23N, R18W, and Section 34, T24N, R18W 16 dry installations in Sections 2, 16, 22, 23, and 26, T23N, R18W, and Sections 23, 28, and 34, T24N, R18W	14 miles new road construction 62.9 miles of road improvement 22-acre gravel pit in Section 24, T23N, R18W
C	24.2	1,563	1,219 (removing 1,114 acres from old-growth status)	Seedtree (789) Seedtree with reserves (461) Shelterwood (29) Shelterwood with reserves (124) Variable thin (160)		3 wet installations in Sections 26 and 34, T24N, R18W 8 dry installations in Section 2, T23N, R18W and Sections 23, 26, 28, and 34, T24N, R18W	9.5 miles new road construction 41.6 miles of road improvement 22-acre gravel pit in Section 24, T23N, R18W
D	15.5	1,186	610 (removing 610 acres from old-growth status)	Seedtree (420) Seedtree with reserves (478) Shelterwood (29) Shelterwood with reserves (124) Variable thin (135)		5 wet installations in Section 16, T23N, R18W, and Sections 26, 28, and 34, T24N, R18W 11 dry installations in Sections 2 and 16, T23N, R18W, and Sections 23, 26, 28, and 34, T24N, R18W	11.2 miles new road construction 60.4 miles of road improvement 22-acre gravel pit in Section 24, T23N, R18W

FIGURE II–1 – ACTION ALTERNATIVE B. Action Alternative B proposed haul routes, units, prescriptions, and gravel pit.

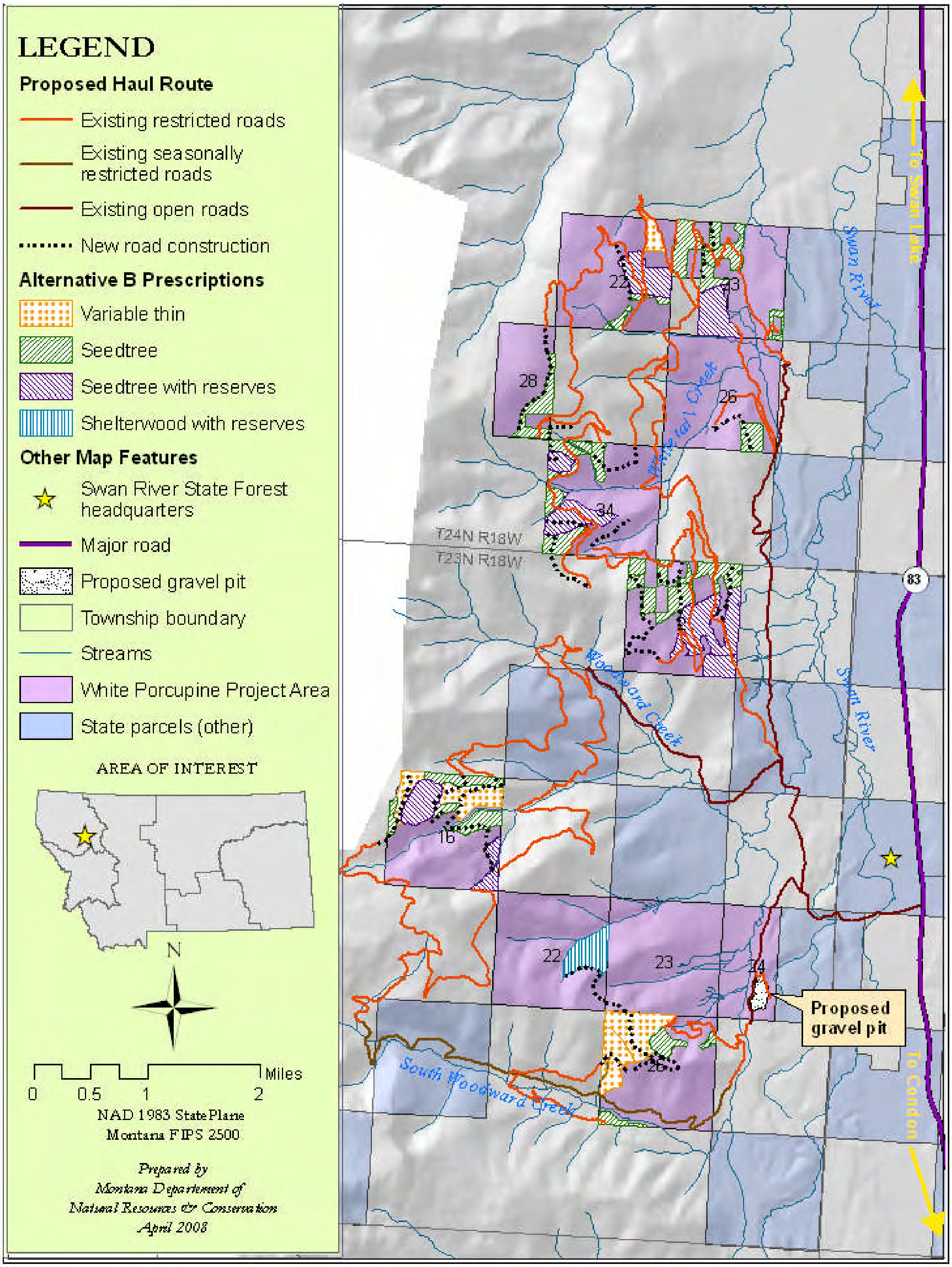


FIGURE II–2 – ACTION ALTERNATIVE C. Action Alternative C proposed haul routes, units, prescriptions, and gravel pit.

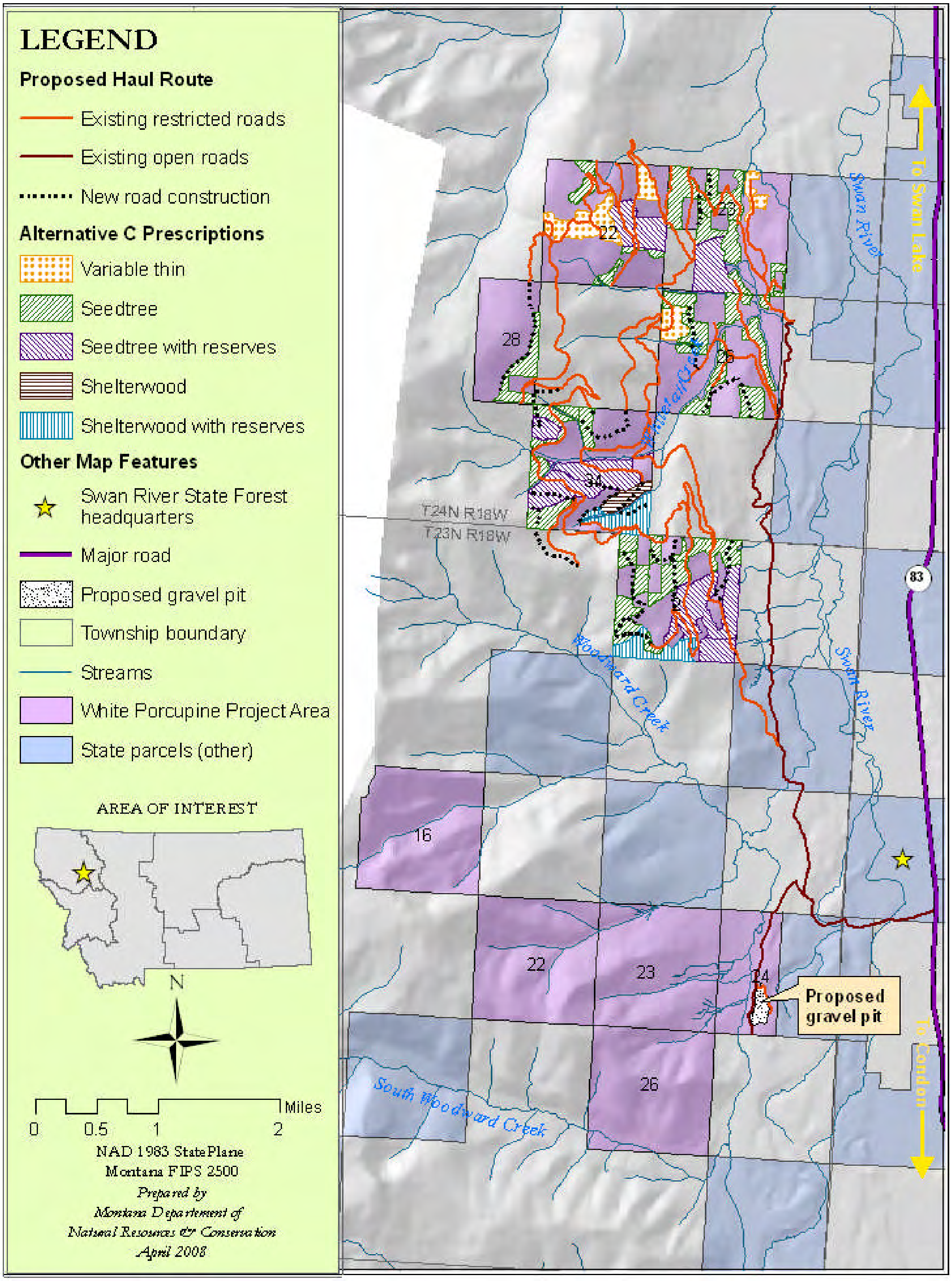
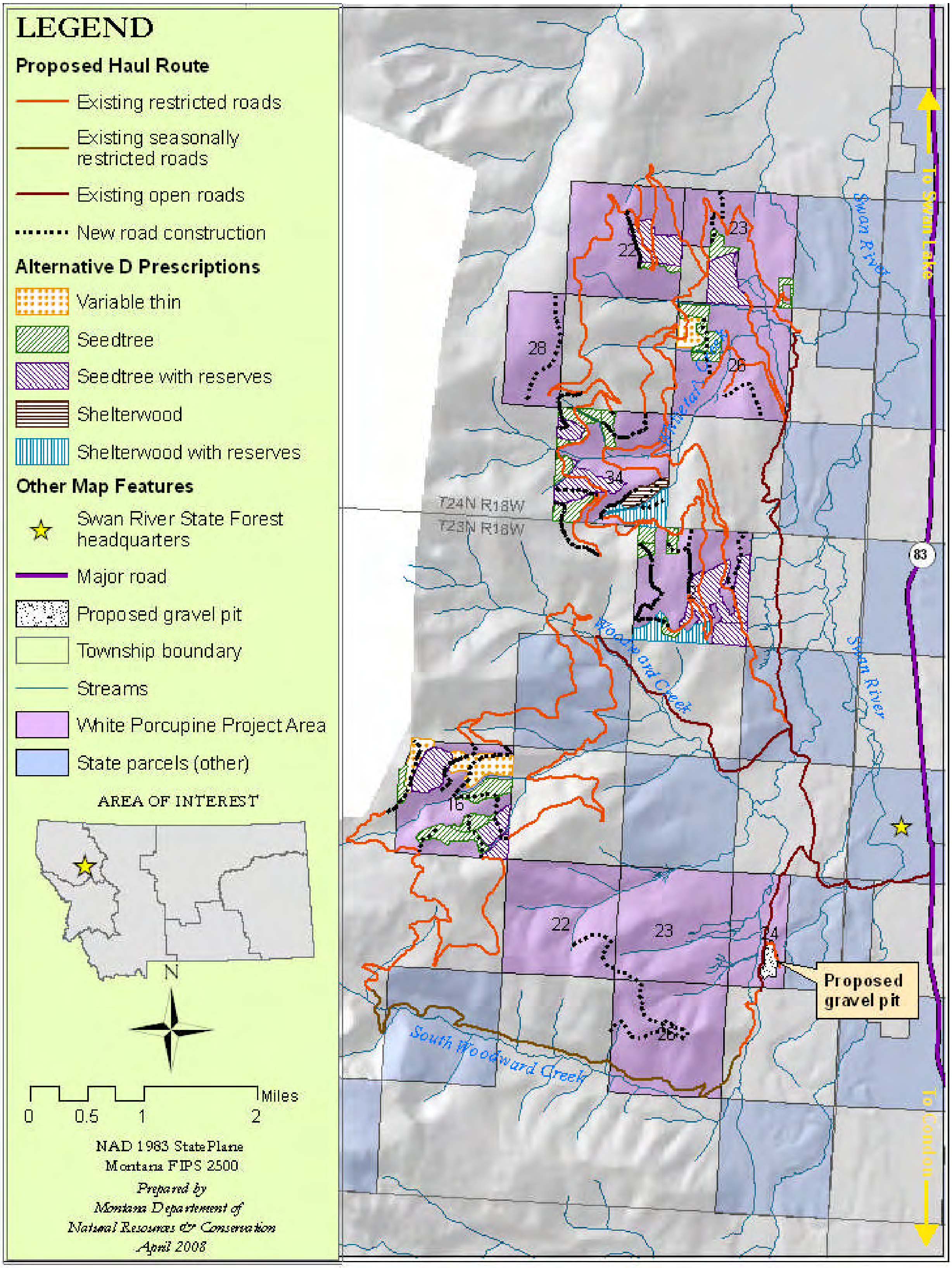


FIGURE II–3 – ACTION ALTERNATIVE D. Action Alternative D proposed haul routes, units, prescriptions, and gravel pit.



ALTERNATIVE ACHIEVEMENT OF PROJECT OBJECTIVES

Following is a list of project objectives with brief identifiers that link the objectives to *TABLE II-2 - ACHIEVEMENT OF OBJECTIVES*, which summarizes how each alternative would achieve the project objectives set forth under *PROJECT OBJECTIVES* in *CHAPTER I - PURPOSE AND NEEDS*. Listed after each objective is an indicator that will be used to measure how and to what extent each alternative meets or measures up to each project objective.

- **Biodiversity** – Promote biodiversity by moving forest stands towards historic covertype conditions and species composition.

  Indicator – Proportional change in covertype acres and age-class acres toward desired future conditions.

- **Insect and Disease** – Improve forest health and productivity by addressing insect and disease issues.

  Indicator – Number of acres treated that are at moderate-to-high and high risk of insect and disease problems.

- **Yield and Revenue** – Meet the sustainable yield for Swan River State Forest in order to accomplish its long-term ecological objectives, maximize long-term revenue for the Common School Trust, and support local communities.

  Indicator – Volume harvested and revenue generated.

- **Transportation** – Develop and improve the transportation system and infrastructure for long-term management, fire suppression, and public access.

  Indicator – Miles of new road construction/road improvements and development costs associated with both.

- **Fuel Loads** – Reduce fuel loads and wildfire hazards by decreasing ground and ladder fuel loads.

  Indicator – Acres treated with seedtree, seedtree-with-reserves, shelterwood, or shelterwood-with-reserves harvest prescriptions.

- **Water quality** – Improve water quality by removing and rehabilitating sediment point sources, and meet BMPs on all project roads, including haul routes to Highway 83.

  Indicator – Number of sediment point sources removed and rehabilitated and miles of road improvement.

TABLE II–2 – ACHIEVEMENT OF OBJECTIVES. Summary comparison of predicted achievement of project objectives for the no-action and

PROJECT OBJECTIVES	**ALTERNATIVES**			
	A	**B**	**C**	**D**
Biodiversity (covertype) *change in acreage* percentages of increase or decrease by project area/ Swan River State Forest	No changes in acreages from existing covertype.	Ponderosa pine *minus 12 acres* 0.19/0.03 percent decreases Western larch/Douglas-fir *plus 59 acres* 0.95/0.15 percent increases Western white pine *plus 282 acres* 4.5/0.72 percent increases Lodgepole pine *0 acres* Mixed conifer *minus 351 acres* 5.68/0.90 percent decreases Subalpine fir *minus 36 acres* 0.58/0.09 percent decreases Douglas-fir *plus 36 acres* 0.58/0.09 percent increases Nonforest/ Nonwater *plus 22 acres* 0.36/0.06 percent increases	Ponderosa pine *minus 12 acres* 0.19/0.03 percent decreases Western larch/Douglas-fir *plus 81 acres* 1.31/0.21 percent increases Western white pine *plus 295 acres* 4.77/0.76 percent increases Lodgepole pine *0 acres* Mixed conifer *minus 386 acres* 6.24/0.99 percent decreases Subalpine fir *0 acres* Douglas-fir *0 acres* Nonforest/ Nonwater *plus 22 acres* 0.36/0.06 percent increases	Ponderosa pine *minus 12 acres* 0.19/0.03 percent decreases Western larch/Douglas-fir *plus 55 acres* 0.89/0.14 percent increases Western white pine *plus 155 acres* 2.51/0.14 percent increases Lodgepole pine *0 acres* Mixed conifer *minus 220 acres* 3.56/0.57 percent decreases Subalpine fir *minus 36 acres* 0.58/0.09 percent decreases Douglas-fir *plus 36 acres* 0.58/0.09 percent increases Nonforest/Nonwater *plus 22 acres* 0.36/0.06 percent increases

PROJECT OBJECTIVES	**ALTERNATIVES**			
	A	**B**	**C**	**D**
Biodiversity (age class*) *change in acreage* percentages of increase or decrease by project area/ Swan River State Forest	No changes in acreages from existing age class.	No age *plus 22 acres* 0.36/0.06 percent increases 0 to 39 years *plus 1,141 acres* 18.46/2.93 percent increases 40 to 99 years *0 acres* 100 to 149 years *plus 34 acres* 0.55/0.09 percent increases 150-plus years *minus 51 acres* 0.82/0.13 percent decreases Old growth *minus 1,146 acres* 18.54/2.94 percent decreases	No age *plus 22 acres* 0.36/0.06 percent increases 0 to 39 years *plus 1,228 acres* 19.86/3.15 percent increases 40 to 99 years *0 acres* 100 to 149 years *plus 88 acres* 1.42/0.23 percent increases 150-plus years *minus 119 acres* 0.92/0.31 percent decreases Old growth *minus 1,219 acres* 19.72/3.13 percent decreases	No age *plus 22 acres* 0.36/0.06 percent increases 0 to 39 years *plus 905 acres* 14.64/2.32 percent increases 40 to 99 years *0 acres* 100 to 149 years *minus 208 acres* 3.36/0.53 percent decreases 150-plus years *minus 109 acres* 1.76/0.28 percent decreases Old growth *minus 610 acres* 9.87/1.57 percent decreases
Insect and disease	0 acres	1,519 acres of moderate-to-high and high levels of insect and disease problems treated	1,186 acres of moderate-to-high and high levels of insect and disease problems treated	1,057 acres of moderate-to-high and high levels of insect and disease problems treated
Yield and revenue	0 MMbf and $0	21.5 MMbf and $1,588,477	24.2 MMbf and $1,949,598	15.5 MMbf and $1,148,446
Transportation	0 miles	14 miles of new road construction at a cost of $554,729 and 62.9 miles of road improvement at a cost of $348,519	9.5 miles of new road construction at a cost of $376,200 and 41.6 miles of road improvement at a cost of $257,715	11.2 miles of new road construction at a cost of $441,831 and 60.4 miles of road improvement at a cost of $332,097

PROJECT OBJECTIVES	ALTERNATIVES			
	A	B	C	D
Fuel loads	0 acres	1,234 acres	1,403 acres	1,051 acres
Water quality	0 replacements and improvements.	Replace 1 bridge and 2 existing culvert crossings that are at risk of failure on Whitetail Creek and replace 1 bridge along Woodward Creek. Road improvements would reduce the amount of sediment per year to South Woodward Creek by 4.2 tons, Woodward Creek by 1.4 tons, and Whitetail Creek by 4.5 tons.	Replace 1 bridge and 2 existing culvert crossings that are at risk of failure on Whitetail Creek. Road improvements would not change the sediment delivery to South Woodward Creek, would reduce the amount of sediment per year to Woodward Creek by 1.6 tons, and Whitetail Creek by 4.7 tons.	Replace 1 bridge and 2 existing culvert crossings that are at risk of failure on Whitetail Creek and replace 1 bridge along Woodward Creek. Road improvements would not change the sediment delivery to South Woodward Creek, would reduce the amount of sediment per year to Woodward Creek by 1.6 tons, and Whitetail Creek by 4.6 tons.

ALTERNATIVE COMPARISON OF ENVIRON-MENTAL EFFECTS

TABLE II–3 – COMPARISON OF EFFECTS summarizes the existing environment and the predicted environmental effects of each alternative. The effects are categorized by resource area and further subdivided by an abbreviated version of the issues listed in *TABLE I-1 – ISSUES STUDIED IN DETAIL*.

TABLE II–3 – COMPARISON OF EFFECTS. Summary comparison of predicted environmental effects of the no-action and action alternatives.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
VEGETATION			
Covertype representation The proposed activities may affect the forest covertypes through species removal or species composition change.	Mixed-conifer stands are currently overrepresented compared to historic data and desired future conditions. Western larch/ Douglas-fir and western white pine covertypes are currently underrepresented on Swan River State Forest.	***No-Action Alternative A***	
		No effects are anticipated.	Shade-tolerant species would continue to regenerate, leading to an increase in the mixed-conifer covertype and a gradual loss of the seral-dominated covertypes, such as western larch/Douglas-fir and western white pine.
		Action Alternative B	
		In the project area, the western larch/ Douglas-fir covertype would increase from 15.4 to 16.4 percent, the western white pine covertype would increase from 19.6 to 24.2 percent, and the mixed-conifer covertype would decrease from 53.8 to 48.1 percent.	Cumulative effects would result in a trend of increasing seral covertypes across areas where management has occurred.
		Action Alternative C	
		In the project area, the western larch/ Douglas-fir covertype would increase from 15.4 to 16.7 percent, the western white pine covertype would increase from 19.6 to 24.4 percent, and the mixed-conifer covertype would decrease from 53.8 to 47.5 percent.	Cumulative effects would result in a trend of increasing seral covertypes across areas where management has occurred.
		Action Alternative D	
		In the project area, the western larch/ Douglas-fir covertype would increase from 15.4 to 16.3 percent, the western white pine covertype would increase from 19.6 to 22.1 percent, and the mixed-conifer covertype would decrease from 53.8 to 50.2 percent.	Cumulative effects would result in a trend of increasing seral covertypes across areas where management has occurred.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
VEGETATION (CONTINUED)			
Age-class representation The proposed activities may affect age classes through tree removal.	Comparison of the current age class distribution by covertype across the entire Swan River State Forest to historical data for Section M333C demonstrates reduced acreage in the seedling-sapling age class and an overabundance in the old-stands age class in most covertypes.	***No-Action Alternative A***	
		No immediate change in the proportion of existing age classes is expected unless a large disturbance, such as a wildfire, occurs.	Cumulative effects would result in a trend of increasing seral covertypes across areas where management occurred.
		Action Alternative B	
		Regeneration treatments and the subsequent planting or natural regeneration would increase the 0–to-39-year age class by 2.9 percent on Swan River State Forest and by 18.5 percent, or 1,141 acres, in the project area. The old-stand age class would be reduced by 3.1 percent on Swan River State Forest and by 19.3 percent, or 1,197 acres, in the project area.	Cumulative effects would result in a trend of reducing the acres in the older age classes while increasing the acres in the younger age classes.
		Action Alternative C	
		Regeneration treatments and subsequent planting or natural regeneration would increase the 0–to-39-year age class by 3.1 percent on Swan River State Forest and by 19.9 percent, or 1,228 acres, in the project area. The old-stand age class would be reduced by 3.4 percent on Swan River State Forest and by 21.6 percent, or 1,328 acres, in the project area.	Cumulative effects would result in a trend of reducing the acres in the older age classes while increasing the acres in the younger age classes.
		Action Alternative D	
		Regeneration treatments and subsequent planting or natural regeneration would increase the 0-to -39-year age class by 2.3 percent on Swan River State Forest and by 14.6 percent, or 905 acres, in the project area. The old-stand age class would be reduced by 1.9 percent on Swan River State Forest and by 11.6 percent, or 719 acres, in the project area.	Cumulative effects would result in a trend of reducing the acres in the older age classes while increasing the acres in the younger age classes.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
VEGETATION (CONTINUED)			
Old-growth representation The proposed activities may affect old-growth amounts and quality through tree removal.	Swan River State Forest currently has 12,116 acres of old growth, which is equal to 31.1 percent of its total acreage. The project area contains 2,722 acres of old growth, which is equal to 44.0 percent of the project area.	***No-Action Alternative A***	
		Existing old-growth stands would continue to experience substantial mortality of large Douglas-fir, grand fir, and western white pine trees, increasing the snag and down woody debris components of those stands. Some stands may no longer be in the old-growth classification as a result of the gradual or sudden loss of many large trees due to insects, diseases, drought, competition, etc.	Current levels of old-growth acres would not change in the short term. As stands continue to mature and large trees eventually die, some stands may no longer meet the old-growth definition.
		Action Alternative B	
		The old-growth amount on Swan River State Forest would decrease to 11,153 acres, which is equal to 28.2 percent of the total acreage. The project area would contain 1,759 acres of old growth, which is equal to 25.5 percent of the project area.	Cumulative effects would result in a trend of reducing the acres in old growth.
		Action Alternative C	
		The old-growth amount on Swan River State Forest would decrease to 11,002 acres, which is equal to 28.0 percent of the total acreage. The project area would contain 1,608 acres of old growth, which is equal to 24.3 percent of the project area.	Cumulative effects would result in a trend of reducing the acres in old growth.
		Action Alternative D	
		The old-growth amount on Swan River State Forest would decrease to 11,506 acres, which is equal to 29.6 percent of the total acreage. The project area would contain 2,112 acres of old growth, which is equal to 34.2 percent of the project area.	Cumulative effects would result in a trend of reducing the acres in old growth.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
VEGETATION (CONTINUED)			
Patch size and shape The proposed activities may affect patch size and shape through tree removal.	Current project area mean patch sizes by age class: None - 24.2 acres 0 to 39 years - 37.2 acres 40 to 99 years - 40.9 acres 100 to old stand - 58.3 acres Old stand - 150.9 acres Overall - 66.9 acres Current project area mean old-growth patch size - 124 acres. Current project area mean patch sizes by covertype: Douglas-fir - 14.4 Lodgepole pine - 28.8 acres Mixed conifer - 221.6 Nonforested - 18.6 acres Nonstocked - 7.6 acres Ponderosa pine - 21.2 acres Subalpine fir - 95 acres Water - 20.5 acres Western larch/ Douglas-fir - 38.2 acres Western white pine - 96.3 acres Overall - 76.7 acres	***No-Action Alternative A*** Age class, old growth, and covertype patch sizes would not be immediately affected. Over time, the forest would tend to homogenize, leading to larger patches of older stands, especially in the absence of significant fires or disturbance events. Over time, the effects to the old-growth patch size would be uncertain. If existing large trees remain alive and new large trees develop in old-age stands, the mean patch size of old growth would likely increase. If existing large trees continue to die and new large trees fail to develop, the mean patch size of old growth would likely decrease. Over time, diversity of habitats in terms of covertype patches would likely be reduced through forest succession, resulting in an increase in mean size of patches dominated by shade-tolerant species. ***Action Alternatives B, C, and D*** The mean old-stand patch size would be reduced to 121.1 acres with Action Alternative B, 104.5 acres with Action Alternative C, and 122.7 acres with Action Alternative D. Other age patches would be only marginally affected except the 0-to-39-year-old class, where mean patches would be increased with each action alternative.	Overall, age patches are reduced from historic conditions and active management has cumulatively increased the overall patch size of younger age classes. Old-growth patches are likely reduced from historic conditions as well. Covertype patch sizes have been reduced from historic conditions. Active management of forested lands suggests an increase in early seral species such as western larch and ponderosa pine. However, the result may also be the retention of a mixed-conifer covertype postharvest. Overall, age-class patches are reduced from historic conditions and active management has cumulatively increased the overall patch size of younger age classes. Old-growth patches and covertype patch sizes have been reduced from historic conditions. Active management of forested lands suggests an increase in early seral species such as western larch and ponderosa pine. However, the result may also be the retention of a mixed-conifer covertype postharvest.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
VEGETATION (CONTINUED)			
Fragmentation The proposed activities may affect fragmentation through road construction and tree removal.	The majority of the project area is a matrix or mosaic of well-stocked stands interspersed with past regeneration harvesting activities. Some man-made patches in harvest units range from 4 to 138 acres while some areas have not been previously entered and represent a continuous forest of stands uninfluenced by human activities, but of various stocking levels due to past insect infestation.	***No-Action Alternative A***	
		No direct effects to forest fragmentation would occur. A reduction in fragmentation would occur if additional harvesting is not imposed by management and existing patches of nonmature forest grow to maturity.	Cumulative effects would result in an increase in fragmentation in areas where regeneration harvest units occur and in a decrease in areas where regeneration harvest units do not occur and existing patches of nonmature forest grow to maturity.
		Action Alternatives B, C, and D	
		For the areas proposed for regeneration harvesting, the primary effects would be creating a larger area of younger stands with a corresponding reduction in mature forest stands with occasional untreated, reserve patches. The areas proposed for variable thinning would be more similar to adjacent mature stands of timber and would not contribute to fragmentation.	An overall increase in the size of younger age-class patches and a decrease in the size of older age classes would occur where regeneration harvest units are proposed.
Vigor The proposed activities may affect the vigor of forest stands through tree removal.	In terms of vigor classifications, the project area consists of 215 acres of full vigor (3.5 percent), 2, 535 acres of good to average vigor (41.0 percent), 1,445 acres of just below average to poor vigor (23.4 percent), and 1,987 acres of poor vigor (32.1 percent).	***No-Action Alternative A***	
		No direct effects for stand vigor would occur. Vigor may increase as insect infestations and disease infections continue to affect stands or if a large disturbance, such as a wildfire, occurs.	Current stand vigor would remain the same across the forest. Mortality and aging of trees or groups of trees would reduce vigor in localized areas. Large reductions in vigor would occur if a large fire came through the area.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
VEGETATION (CONTINUED)			
		Action Alternative B	
		Vigor classifications as a result of Action Alternative B would consist of 1,449 acres of good vigor (23.4 percent), 2,696 acres of good to average vigor (43.6 percent), 1,293 acres of just below average to poor vigor (20.9 percent), 722 acres of poor vigor (11.7 percent), and 22 acres of nonforest-nonwater ground due to the gravel pit development (0.4 percent).	Areas where harvesting has occurred would have increased vigor. Areas where harvesting has not occurred would have decreased vigor and the trees would no longer perform to their highest potential, would become susceptible to insects and diseases, etc.
		Action Alternatives C	
		Vigor classifications as a result of Action Alternative C would consist of 1,653 acres of good vigor (26.7 percent), 2,479 acres of good to average vigor (40.1 percent), 1,256 acres of just below average to poor vigor (20.3 percent), 772 acres of poor vigor (12.5 percent), and 22 acres of nonforest-nonwater ground due to the gravel pit development (0.4 percent).	Areas where harvesting has occurred would have increased vigor. Areas where harvesting has not occurred would have decreased vigor and the trees would no longer perform to their highest potential, would become susceptible to insects and diseases, etc.
		Action Alternative D	
		Vigor classifications as a result of Action Alternative D would consist of 1,300 acres of good vigor (21.0 percent), 2,472 acres of good to average vigor (40.0 percent), 1,352 acres of just below average to poor vigor (21.9 percent), 1,036 acres of poor vigor (16.8 percent), and 22 acres of nonforest-nonwater ground due to the gravel pit development (0.4 percent).	Areas where harvesting has occurred would have increased vigor. Areas where harvesting has not occurred would have decreased vigor and the trees would no longer perform to their highest potential, would become susceptible to insects and diseases, etc.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
VEGETATION (CONTINUED)			
Stand structure The proposed activities may affect the forest stand structure through tree removal.	Current stand structure classifications and percentages in the project area: single-storied - 20.4 percent, two-storied - 21.7 percent, multistoried - 26.0 percent, heterogeneous - 5.2 percent, and classic uneven-aged - 26.7 percent.	***No-Action Alternative A***	
		No immediate change in the proportion of stand structure is expected unless a large disturbance, such as wild fire, occurs.	The cumulative effects to stand structure distributions due to previous activities are represented in descriptions of the current conditions. Those effects have been to reduce the acres in multistoried or classic uneven-aged stand structures while increasing the acres in the single-storied stand structure through even-aged management.
		Action Alternative B	
		The following stand structure proportions would change. The single-storied stand would increase 1,117 acres (38.6 percent), while the two-storied stand would decrease 177 acres (18.9 percent), the multistoried stand 242 acres (22.0 percent), and the classic uneven-aged stand 709 acres (15.3 percent). Twenty-two acres would incrementally be removed from the stand-structure category through gravel pit development.	The cumulative effects to stand structure distributions due to previous activities are represented in descriptions of the current conditions. Those effects have been to reduce the acres in the multistoried or classic uneven-aged stand structures while increasing the acres in the single-storied stand structure through even-aged management.
		Action Alternative C	
		The following stand structure proportions would change. The single-storied stand would increase 1,197 acres (39.9 percent) and the two-storied stand 2 acres (21.8 percent), while the multistoried stand would decrease 12 acres (25.9 percent), heterogeneous stand 19 acres (4.9 percent), and the classic uneven-aged stand 1,189 acres (7.5 percent);. Twenty-two acres would incrementally be removed from the stand structure category through gravel pit development.	The cumulative effects to stand structure distributions due to previous activities are represented in descriptions of the current conditions. Those effects have been to reduce the acres in the multistoried or classic uneven-aged stand structures while increasing the acres in the single-storied stand structure through even-aged management.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
VEGETATION (CONTINUED)			
		Action Alternative D	
		The following stand structure proportions would change. The single-storied stand would increase 833 acres (34.0 percent) and the two-storied stand 82 acres (23.1 percent), while the multistoried stand would decrease 320 acres (20.9 percent), and the classic uneven-aged stand 616 acres (16.8 percent);. Twenty-two acres would incrementally be removed from the stand structure category through gravel pit development.	The cumulative effects to stand structure distributions due to previous activities are represented in descriptions of the current conditions. Those effects have been to reduce the acres in the multistoried or classic uneven-aged stand structures while increasing the acres in the single-storied stand structure through even-aged management.
Crown cover The proposed activities may affect the forest crown cover through tree removal.	In terms of overall crown cover in the project area, 59.6 percent of stands are well-stocked, 16.9 percent show medium stocking, 20.6 percent are poorly stocked, 1.0 percent are nonstocked, and 1.9 percent are nonforested. Sawtimber stocking in the project area shows that 23.9 percent of stands are well stocked, 19.4 percent of stands have medium stocking, and 27.5 percent are poorly stocked.	***No-Action Alternative A***	
		Overall crown cover and stocking would likely increase over time in the absence of disturbances. Were large fires to occur, overall crown cover would be reduced. Ongoing insect and disease issues would reduce crown cover and sawtimber stocking in some areas prior to understory regeneration.	Current crown cover would remain the same across the forest. Over time, crown cover would be expected to increase in the absence of disturbance. Mortality of trees or groups of trees would reduce the crown cover in localized areas. Large reductions in crown cover would occur if a large fire came through the area.
		Action Alternative B	
		The project area would consist of approximately 36.0 percent well-stocked stands, 20.1 percent medium-stocked stands, 40.6 percent poorly-stocked stands, 1.0 percent nonstocked stands, and 2.3 percent nonforested stands.	Overall reductions of crown cover in well-stocked stands would be dispersed across the landscape. Representation of medium-stocked stands would increase following harvesting, as would poorly stocked stands. As stands regenerate, crown cover would increase.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
VEGETATION (CONTINUED)			
		Action Alternative C	
		The project area would consist of approximately 35.2 percent well-stocked stands, 18.2 percent medium-stocked stands, 43.3 percent poorly-stocked stands, 1.0 percent nonstocked stands, and 2.3 percent nonforested stands.	Overall reductions of crown cover in well-stocked stands would be dispersed across the landscape. Representation of medium-stocked stands would increase following harvesting, as would poorly stocked stands. As stands regenerate, crown cover would increase.
		Action Alternative D	
		The project area would consist of approximately 41.0 percent well-stocked stands, 18.1 percent medium-stocked stands, 37.6 percent poorly-stocked stands, 1.0 percent nonstocked stands, and 2.3 percent nonforested stands.	Overall reductions of crown cover in well-stocked stands would be dispersed across the landscape. Representation of medium-stocked stands would increase following harvesting, as would poorly stocked stands. As stands regenerate, crown cover would increase.
Insects and diseases The proposed activities may affect forest insect and disease levels through tree removal (both suppressed/ stressed and infested/ infected).	The major forest insects and diseases currently affecting forest productivity on Swan River State Forest include Armillaria root disease, red-brown butt rot, larch dwarf mistletoe, white pine blister rust, Indian paint fungus, red ring rot, Douglas-fir bark beetle, fir engraver, and mountain pine beetle.	***No-Action Alternative A***	
		Sawlog volume, and the corresponding revenue, would continue to be lost from the project area due to insect and disease effects in inaccessible stands with large trees. Salvage logging would continue where stands are accessible without building roads.	Some salvage harvesting of insect-infested and disease-infected trees would occur, but at a slower, less effective rate and not in association with this project. Forest stands would maintain dense stocking levels, which contribute to the spread of insects, diseases, and fuel loading, which could lead to high-intensity fires, unnatural forest structures, and overall poor stand health . Current forest conditions would continue.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
VEGETATION (CONTINUED)			
		Action Alternatives B, C, and D	
		Harvest treatments would remove trees affected by insects and diseases. Action Alternative B (treating 1,519 acres) with moderate-to-high and high levels of insect and disease issues would do the most to control rates of spread, economic value loss, and volume loss in the project area. The other action alternatives in order of decreasing efficacy in treating insect and disease issues would be Action Alternatives C (treating 1,186 acres) and D (treating 665 acres).	Timber-management activities generally implement prescriptions that reduce losses and recover mortality due to insects and diseases. Stand-regeneration treatments are producing stands with species compositions more resilient to the impacts of forest insects and diseases. Thinning treatments have further reduced the percentage of infected or infested trees.
Fire effects The proposed activities may affect forest fire conditions, levels, and hazards through tree removal, increased public access, and/or fuel reduction.	The fire regime across Swan River State Forest is variable in frequency and intensity and is creating a mosaic pattern of age classes and covertypes.	***No-Action Alternative A***	
		Wildfire hazards would not change substantially in the short term. With continued fuel accumulation from down woody debris, the potential for wildfire increases. Large-scale, stand-replacing fires may be the outcome.	The risk of wildfires would continue to increase as a result of long-term fire suppression.
		Action Alternatives B, C, and D	
		Immediately following timber harvesting, the amount of fine fuels would increase. Hazards would be reduced through various fuel-treatment measures such as piling and burning.	Fuel loadings would be reduced in treated stands, decreasing wildfire risks in these specific areas.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
VEGETATION (CONTINUED)			
Sensitive Plants The proposed activities may affect sensitive plant populations through ground disturbance.	The majority of sensitive plants and their related habitat features were found in wet meadows, which are not normally classified as forest stands or considered for timber harvesting. No species of concern were found in the proposed units.	***No-Action Alternative A***	
		No effects are anticipated.	No effects are anticipated.
		Action Alternatives B, C, and D	
		No effects are expected because no populations of sensitive plants occur in the harvest units.	If changes occur in the water yield or nutrient level, sensitive plant populations may, in turn, be affected. Given the level of the proposed and active harvesting on Swan River State Forest and other land in the project area, no measurable changes in water yield or nutrient levels are anticipated from any of the proposed action alternatives.
Noxious weeds The proposed activities may affect noxious weed populations and presence through ground disturbance and weed introduction.	Spotted knapweed (*Centaurea mauclosa* Lam.), orange hawkweed (*Hieracium aurantiacum*), and common St. John's-wort (*Hypericum perforatum* L.) have become established along road edges in the project area.	***No-Action Alternative A***	
		Weed seed would continue to be introduced by recreational use of the forest, log hauling, and other logging activities on adjacent land ownerships. Swan River State Forest may initiate spot spraying to reduce noxious weed spread along its roads under the FI program.	Current population levels would continue to exist and may increase over time.
		Action Alternatives B, C, and D	
		Log hauling and equipment movement would introduce seeds from other sites. Weed establishment and spread would be reduced by grass seeding new and disturbed roads and landings, spot spraying of new infestations, requiring contractors to wash and have machinery inspected prior to entering the project area, and roadside herbicide spraying.	The action alternatives, together with other management and recreational activities on Swan River State Forest, would provide an opportunity for the transfer of weed seeds and increased establishment of noxious weeds. Preventative actions facilitated by the Lake County Weed Board and active weed-management activities performed by Swan River State Forest would reduce the spread and establishment of noxious weeds, as well as the impacts resulting from the replacement of native species.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WATERSHED AND HYDROLOGY			
Sediment delivery Timber harvesting and related activities, such as road construction, can lead to water-quality impacts by increasing the production and delivery of fine sediment to streams.	Current estimates of sediment delivered to the streams from roads per year are: South Woodward Creek – 23.6 tons Woodward Creek – 3.5 tons Whitetail Creek – 5.9 tons	***No-Action Alternative A***	
		No changes would occur.	Conditions would be similar to the existing conditions.
		Action Alternative B	
		Road improvements would reduce the amount of sediment per year to South Woodward Creek by 4.2 tons, Woodward Creek by 1.4 tons, and Whitetail Creek by 4.5 tons.	Sediment delivery per year would be reduced to 19.4 tons for South Woodward Creek, 2.1 tons for Woodward Creek, and 1.4 tons for Whitetail Creek.
		Action Alternative C	
		Road improvements would not change the sediment delivery to South Woodward Creek and would reduce the amount of sediment per year to Woodward Creek by 1.6 tons, and Whitetail Creek by 4.7 tons.	Sediment delivery per year would remain at 23.6 tons for South Woodward Creek and would be reduced to 1.9 tons for Woodward Creek and 1.2 tons for Whitetail Creek.
		Action Alternative D	
		Road improvements would not change the sediment delivery to South Woodward Creek and would reduce the amount of sediment per year to Woodward Creek by 1.6 tons and Whitetail Creek by 4.6 tons.	Sediment delivery per year would remain at 23.6 tons for South Woodward Creek and would be reduced to 1.9 tons for Woodward Creek and 1.3 tons for Whitetail Creek.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WATERSHED AND HYDROLOGY (CONTINUED)			
Water yield Timber harvesting and associated activities can affect the timing, distribution, and amount of water yield in a harvested watershed.	The water yield is presently over the naturally occurring level in the South Woodward Creek watershed by about 8.3 percent, the Woodward Creek watershed by about 7.2 percent, the Whitetail Creek watershed by about 7.4 percent, and the East Porcupine Creek watershed by about 6.6 percent.	***No-Action Alternative A***	
		No changes would occur.	No changes would occur.
		Action Alternative B	
		Water yield would increase in the South Woodward Creek (0.6 percent), Woodward Creek (2.0 percent), Whitetail Creek (4.6 percent), and East Porcupine Creek (1.7 percent) watersheds.	The total increase in water yield above naturally occurring levels would occur in South Woodward Creek (8.9 percent), Woodward Creek (9.2 percent), Whitetail Creek (12.0 percent), and East Porcupine Creek (8.3 percent) watersheds.
		Action Alternative C	
		Water yield would not increase in the South Woodward Creek watershed, would increase in the Woodward Creek (0.6 percent), Whitetail Creek (6.5 percent), and East Porcupine Creek (3.5 percent) watersheds. Water-yield increases expected in the Whitetail Creek watershed would occur slightly above the established threshold of concern. Given the channel-stability ratings of Whitetail Creek, adverse impacts to its stream channel would be unlikely. Adverse impacts that may occur in individual reaches of Whitetail Creek would be expected to recover in less than 10 years.	The total increase in water yield above naturally occurring levels would occur in the South Woodward Creek (8.3 percent), Woodward Creek (7.8 percent), Whitetail Creek (13.9 percent), and East Porcupine Creek (10.1 percent) watersheds.
		Action Alternative D	
		Water yield would not increase in the South Woodward Creek and East Porcupine Creek watersheds, would increase in the Woodward Creek (2.5 percent) and Whitetail Creek wate (4.0 percent) watersheds,	The total increase in water yield above naturally occurring levels would be in the South Woodward Creek (8.3 percent), Woodward Creek (9.7 percent), Whitetail Creek (11.4 percent), and East Porcupine Creek (6.6 percent) watersheds.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
FISHERIES			
Populations The proposed actions may affect fisheries population.	The Whitetail Creek analysis area is the only area expected to be affected by the proposed actions. Existing impacts to native-fish populations in the analysis area are high.	***No-Action Alternative A***	
		No additional impacts would occur in the Whitetail Creek analysis area.	See *Cumulative Effects* summary below
		Action Alternatives B, C, and D	
		A positive impact to native-fish populations in the analysis area is expected.	See *Cumulative Effects* summary below
Flow regime The proposed actions may affect the fisheries habitat feature of flow regime	The following 5 analysis areas are expected to be affected by the proposed actions: South Woodward Creek, Swan Face Drainages, Unnamed Tributary to Porcupine Creek, Whitetail Creek, and Woodward Creek. Existing impacts to flow regime in these analysis areas are low.	***No-Action Alternative A***	
		No additional impacts would occur in the affected analysis areas.	See *Cumulative Effects* summary below
		Action Alternative B	
		A moderate risk of additional very low impacts would occur in the South Woodward Creek, Unnamed Tributary to Porcupine Creek, and Woodward Creek analysis areas. A moderate risk of additional low impacts would occur in the Swan Face Drainages and Whitetail Creek analysis areas.	See *Cumulative Effects* summary below
		Action Alternative C	
		No additional impacts would occur in the South Woodward Creek analysis area, but a moderate to high risk of additional low impacts would occur in the Whitetail Creek analysis area. Foreseeable impacts to the Swan Face Drainages and Woodward Creek analysis areas would be the same as Action Alternative B. A moderate risk of additional low impacts would occur in the Unnamed Tributary to Porcupine Creek analysis area.	See *Cumulative Effects* summary below

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
FISHERIES (CONTINUED)			
		Action Alternative D	
		No additional impacts would occur in the South Woodward Creek and Unnamed Tributary to Porcupine Creek analysis areas. Foreseeable impacts to the Swan Face Drainages, Whitetail Creek, and Woodward Creek analysis areas would be the same as Action Alternative B.	See *Cumulative Effects* summary below
Sediment delivery The proposed actions may affect the fisheries habitat feature of sediment.	Existing impacts to sediment are low in all analysis areas except for low to moderate impacts in the South Woodward Creek analysis area, very low impacts in the Swan River analysis area, and no impacts in the Unnamed Tributary to Porcupine Creek analysis area.	***No-Action Alternative A***	
		No additional impacts would occur in the analysis areas.	See *Cumulative Effects* summary below
		Action Alternative B	
		A low risk of additional low impacts would occur in all analysis areas except the Unnamed Tributary to Porcupine Creek analysis area, where a low risk of additional very low impacts is expected, and the Whitetail Creek analysis area. The Whitetail Creek analysis area would have a high risk of moderate short-term impacts and a low risk of low long-term impacts.	See *Cumulative Effects* summary below
		Action Alternative C	
		No additional impacts would occur in the South Woodward Creek analysis area. Foreseeable impacts to all other analysis areas would be the same as Action Alternative B.	See *Cumulative Effects* summary below
		Action Alternative D	
		No additional impacts would occur in the Unnamed Tributary to Porcupine Creek analysis area. Foreseeable impacts to all other analysis areas would be the same as Action Alternative B.	See *Cumulative Effects* summary below

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
FISHERIES (CONTINUED)			
Channel form The proposed actions may affect the fisheries habitat feature of channel forms.	The following 5 analysis areas are expected to be affected by the proposed actions: South Woodward Creek, Swan Face Drainages, Unnamed Tributary to Porcupine Creek, Whitetail Creek, and Woodward Creek. No existing impacts to channel forms occur in these analysis areas, except in the Woodward Creek analysis area where a moderate existing impact occurs.	***No-Action Alternative A***	
		No additional impacts would occur in the affected analysis areas.	See *Cumulative Effects* summary below
		Action Alternative B	
		A risk of additional low impacts would occur in all affected analysis areas.	See *Cumulative Effects* summary below
		Action Alternative C	
		No additional impacts would occur in the South Woodward Creek analysis area. Foreseeable impacts to all other affected analysis areas would be the same as Action Alternative B.	See *Cumulative Effects* summary below
		Action Alternative D	
		A low risk of additional very low impacts would occur in the South Woodward Creek analysis area, and no additional impacts would occur in the Unnamed Tributary to Porcupine Creek analysis area. Foreseeable impacts to all other affected analysis areas would be the same as Action Alternative B.	See *Cumulative Effects* summary below
Riparian function The proposed actions may affect the fisheries habitat feature of riparian condition.	The following 3 analysis areas are expected to be affected by the proposed actions: South Woodward Creek, Unnamed Tributary to Porcupine Creek and Whitetail Creek. No existing impacts to the riparian condition occur in these analysis areas, except in the Whitetail Creek analysis area where low to moderate existing impact occurs.	***No-Action Alternative A***	
		No additional impacts would occur in the affected analysis areas.	See *Cumulative Effects* summary below
		Action Alternative B	
		No additional impacts would occur in the Unnamed Tributary to Porcupine Creek analysis area. A very low risk of additional low impacts would occur in the South Woodward Creek analysis area, and a low risk of additional low impacts would occur in the Whitetail Creek analysis area.	See *Cumulative Effects* summary below

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
FISHERIES (CONTINUED)			
		Action Alternative C	
		No additional impacts would occur in the South Woodward Creek and Unnamed Tributary to Porcupine Creek analysis areas. A low risk of additional low impacts would occur in the Whitetail Creek analysis area.	See *Cumulative Effects* summary below
		Action Alternative D	
		Foreseeable impacts would be the same as Action Alternative C.	See *Cumulative Effects* summary below
Large woody debris The proposed actions may affect the fisheries habitat feature of large woody debris.	The following 3 analysis areas are expected to be affected by the proposed actions: South Woodward Creek, Unnamed Tributary to Porcupine Creek, and Whitetail Creek. No existing impacts to large woody debris occur in these analysis areas.	***No-Action Alternative A***	
		No additional impacts would occur in the affected analysis areas.	See *Cumulative Effects* summary below
		Action Alternative B	
		No additional impacts would occur in the Unnamed Tributary to Porcupine Creek analysis area. A very low risk of additional low impacts would occur in the South Woodward Creek analysis area, and a low risk of additional low impacts would occur in the Whitetail Creek analysis area.	See *Cumulative Effects* summary below
		Action Alternative C	
		No additional impacts would occur in the South Woodward Creek and Unnamed Tributary to Porcupine Creek analysis areas. A low risk of additional low impacts would occur in the Whitetail Creek analysis area.	See *Cumulative Effects* summary below
		Action Alternative D	
		Foreseeable impacts would be the same as Action Alternative C.	See *Cumulative Effects* summary below

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
FISHERIES (CONTINUED)			
Stream temperature The proposed actions may affect the fisheries habitat feature of stream temperature.	The following 3 analysis areas are expected to be affected by the proposed actions: South Woodward Creek, Unnamed Tributary to Porcupine Creek, and Whitetail Creek. No existing impacts to stream temperature occur in these analysis areas.	***No-Action Alternative A***	
		No additional impacts would occur in the affected analysis areas.	See *Cumulative Effects* summary below
		Action Alternative B	
		No additional impacts would occur in the Unnamed Tributary to Porcupine Creek analysis area. A very low risk of additional low impacts would occur in the South Woodward Creek analysis area, and a low risk of additional low impacts would occur in the Whitetail Creek analysis area.	See *Cumulative Effects* summary below
		Action Alternative C	
		No additional impacts would occur in the South Woodward Creek and Unnamed Tributary to Porcupine Creek analysis areas. A low risk of additional low impacts would occur in the Whitetail Creek analysis area.	See *Cumulative Effects* summary below
		Action Alternative D	
		No additional impacts would occur in the Unnamed Tributary to Porcupine Creek analysis area. A risk of additional very low impacts would occur in the South Woodward Creek analysis area, and a low risk of additional low impacts would occur in the Whitetail Creek analysis area.	See *Cumulative Effects* summary below

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
FISHERIES (CONTINUED)			
Macroinvertebrate richness The proposed actions may affect the fisheries habitat feature of macroinvertebrate richness.	The following 5 analysis areas are expected to be affected by the proposed actions: South Woodward Creek, Swan Face Drainages, Unnamed Tributary to Porcupine Creek, Whitetail Creek, and Woodward Creek. No existing impacts to macroinvertebrate richness occur in these analysis areas, except in the Whitetail Creek analysis area where a very low to low existing impact occurs and the Woodward Creek analysis area where a low existing impact occurs.	***No-Action Alternative A***	
		No additional impacts would occur in the affected analysis areas.	See *Cumulative Effects* summary below
		Action Alternative B	
		A very low risk of additional low impacts would occur in the South Woodward Creek analysis area. A risk of additional low impacts would occur in all other affected analysis areas.	See *Cumulative Effects* summary below
		Action Alternative C	
		No additional impacts would occur in the South Woodward Creek analysis area. A risk of additional low impacts would occur in all other affected analysis areas.	See *Cumulative Effects* summary below
		Action Alternative D	
		A risk of additional very low impacts would occur in the South Woodward Creek analysis area, and no additional impacts would occur in the Unnamed Tributary to Porcupine Creek analysis area. A risk of additional low impacts would occur in all other affected analysis areas.	See *Cumulative Effects* summary below
Connectivity The proposed actions may affect the fisheries habitat feature of connectivity.	The Whitetail Creek analysis area is the only area expected to be affected by the proposed actions. Existing impacts to native-fish connectivity in the analysis area are moderate to high at 2 different sites.	***No-Action Alternative A***	
		No additional impacts would occur in the Whitetail Creek analysis area.	See *Cumulative Effects* summary below
		Action Alternatives B, C, and D	
		A positive impact to native-fish connectivity is expected to occur at 1 site, and no additional impact would occur at the other location.	See *Cumulative Effects* summary below

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
FISHERIES (CONTINUED)			
The proposed actions may have cumulative effects to fisheries resources.	Moderate cumulative impacts exist in all analysis areas except for low to moderate existing cumulative impacts in the Unnamed Tributary to Porcupine Creek and the Unnamed Tributary to Swan River analysis areas.	***No-Action Alternative A***	
		Not applicable	A moderate risk of moderate cumulative impacts is expected to remain in all analysis areas except for a moderate risk of low to moderate cumulative impacts that is expected to remain in the Unnamed Tributary to Porcupine Creek and the Unnamed Tributary to Swan River analysis areas.
		Action Alternative B	
		Not applicable	A moderate to high risk of moderate cumulative impacts is expected to occur in the South Woodward Creek and Whitetail Creek analysis areas. Foreseeable cumulative impacts in all other analysis areas are expected to be similar to No-Action Alternative A.
		Action Alternative C	
		Not applicable	A high risk of moderate cumulative impacts is expected to occur in the Whitetail Creek analysis area. Foreseeable cumulative impacts in all other analysis areas are expected to be similar to No-Action Alternative A.
		Action Alternative D	
		Not applicable	A moderate to high risk of moderate cumulative impacts is expected to occur in the Whitetail Creek analysis area. Foreseeable cumulative impacts in all other analysis areas are expected to be similar to No-Action Alternative A.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE			
Covertype distribution The proposed activities could result in changes in the distribution of different covertypes on the landscape, which could affect wildlife species.	Mixed-conifer covertypes are overrepresented, which has led to increased habitat availability for species that use dense stands that include a variety of tree species while providing fewer habitats for those species that use the more-open stands dominated by shade-intolerant tree species.	***No-Action Alternative A***	
		Loss of habitat would increase for wildlife species associated with shade-intolerant covertypes, but species associated with shade-tolerant covertypes could benefit.	No short-term effects and slight negative long-term effects for wildlife species associated with shade-intolerant covertypes would be expected.
		Action Alternatives B, C, and D	
		Covertypes would be converted from shade-tolerant to shade-intolerant on 337, 376, or 245 acres, respectively, and thus provide more habitat for species associated with the shade-intolerant covertypes once the stands regenerate.	Any of the alternatives would be expected to result in slightly positive effects for species that use shade-intolerant covertypes at the expense of those that use shade-intolerant types.
Age classes The proposed activities could alter the representation of stand-age classes on the landscape, which could affect wildlife species.	Habitat availability for species that use younger-aged stands is relatively low, but is abundant habitat for those species that use mature forested stands in the project area. In the cumulative-effects analysis area (Swan River State Forest), mature forest exists in high proportions.	***No-Action Alternative A***	
		No short-term effects would be expected; in the longer term, this alternative could lead to a reduction in habitat for species associated with the younger age class forest conditions.	Because no changes to age class would result under this alternative, no cumulative effects to age-class distributions in the analysis area would be expected.
		Action Alternatives B, C, and D	
		Older-aged stands would be regenerated on 1,234, 1,403 , or 1,051 acres, respectively, leading to a reduction in habitat for species associated with old stands, while wildlife species that use meadows and early successional forests would benefit from an increase in habitat availability.	The cumulative effects to wildlife species would be slightly negative to species associated with older forest stands, but habitat proportions would more closely reflect the proportions under which wildlife in western Montana evolved, resulting in potential benefits to biodiversity.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Old-growth-associated species The proposed activities could affect wildlife species associated with old-growth forests.	Approximately 2,722 acres of old growth currently exist in the project area, representing 44 percent of the project area. Six of the 22 patches are larger than 80 acres. In the cumulative-effects analysis area (Swan River State Forest), old growth is abundant on DNRC-managed lands (12,116 acres) and USFS lands, but rare on Plum Creek lands.	***No-Action Alternative A***	
		Old-growth amounts would not change, and patch sizes of old growth would not decrease in the short term. No effects to wildlife associated with old-growth forests would be expected.	No cumulative effects to old-growth-associated wildlife species would be anticipated.
		Action Alternative B	
		The total amount of old growth in the project area would be reduced by 35 percent, but the number and relative size of large patches would remain the same. Minor negative effects to wildlife associated with the old-growth forest would be expected.	Although loss of habitat would occur with the removal of old-growth habitats on 963 acres in the project area, the amount of old-growth postharvest would remain relatively high in the cumulative-effects analysis area and multiple large patches of old-growth habitats would be available. Low levels of negative cumulative effects to wildlife species associated with old-growth habitats would be expected.
		Action Alternative C	
		Old growth amounts would be reduced by 41 percent, and large patches of old growth would be reduced in the project area. Moderate negative effects to wildlife associated with old-growth forests would be anticipated, although the effects would be localized in the Whitetail drainage.	Although loss of habitat would occur with the removal of old-growth habitats on 1,114 acres in the project area, the amount of old-growth postharvest would remain relatively high in the cumulative-effects analysis area and multiple large patches of old-growth habitats would be available. Low levels of negative cumulative effects to wildlife species associated with old-growth habitats would be expected.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
		Action Alternative D	
		Old-growth habitat would be reduced by 22 percent and large patches of old growth would remain abundant in the Project Area. Minor negative effects to old-growth-associated wildlife would be expected.	Although loss of habitat would occur with the removal of old-growth habitats on 610 acres in the project area, the amount of old-growth postharvest would remain relatively high in the cumulative-effects analysis area and multiple large patches of old-growth habitats would be available. Low levels of negative cumulative effects to wildlife species associated with old-growth habitats would be expected.
Connectivity The proposed activities could result in disturbance or alteration of forested corridors and connectivity, which could inhibit wildlife movements.	Forest connectivity has been relatively well maintained in the project area. Currently 4,403 acres (70 percent) of the project area provide habitats that would allow movement for forest-dwelling species. In general, connectivity of forested habitats is fairly intact in the cumulative-effects analysis area.	***No-Action Alternative A***	
		No short-term effects and slightly positive long-term effects to forested connectivity in the project area would be expected.	No negative effects to forested connectivity for wildlife species would be expected.
		Action Alternative B	
		The amount of connective forest would be reduced by 871 acres. Connectivity would be affected the greatest in the northernmost and southernmost parts of the project area, mostly in upland areas, and connectivity would be well maintained along the major drainages and ridgelines. Minor effects to connectivity for wildlife species in the project area would be expected.	Connective forest would be decreased by 20 percent in the project area, but connectivity throughout the cumulative-effects analysis area would remain fairly intact, especially along streams and ridges. Thus, minor negative cumulative effects to wildlife species would be expected.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
		Action Alternative C	
		Connective forest would be reduced by 1,001 acres. Connectivity would be impacted most heavily in the uplands of the Whitetail drainage (other drainages in the project area would not be affected). Moderate effects to wildlife connectivity in the project area would be expected.	Connective forest would be decreased by 23 percent in the project area, but connectivity throughout the cumulative-effects analysis area would remain fairly intact, especially along streams and ridges. Thus, minor negative cumulative effects to wildlife species would be expected.
		Action Alternative D	
		Connective forest would be reduced by 821 acres. The effects would be dispersed throughout the project area, and connectivity along major drainages and ridges would be retained. Minor negative effects to wildlife connectivity in the project area would be expected.	Connective forest would be decreased by 19 percent in the project area, but connectivity throughout the cumulative-effects analysis area would remain fairly intact, especially along streams and ridges. Thus, minor negative cumulative effects to wildlife species would be expected.
Linkage The proposed activities could reduce forested cover, which could adversely affect habitat linkage for wildlife.	In the project area and cumulative-effects analysis areas, linkage potential is currently very good, human development is low, riparian areas are abundant and heavily vegetated, open-road densities are relatively low, and hiding cover is relatively high.	***No-Action Alternative A*** Open- and total-road densities would not increase, human development and disturbance would not increase, and cover would not be affected. No effects to wildlife linkage would be expected.	No cumulative effects to linkage would be expected.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
		Action Alternatives B, C, and D	
		Open-road densities would not increase, but road usage would temporarily increase, and total-road densities would increase by 14.0, 9.5, or 11.2 miles, respectively. Disturbance would slightly increase with the development and operation of a 22-acre gravel pit. Hiding cover would decrease by 28, 30, or 22 percent, respectively. Moderate short-term effects (during harvesting) and minor long-term negative effects to linkage would be expected under any of the action alternatives.	The proposed action alternatives would similarly: 1) increase total-road densities and commercial road usage in parts of the cumulative-effects analysis area, though not increase open-road densities; 2) increase human disturbance with the development of a low-use gravel pit; and 3) minimally decrease cover in the cumulative-effects analysis area (though hiding cover would remain on 75, 74, or 76 percent of the cumulative-effects analysis area, respectively), and some negative cumulative effects to linkage would be expected, but the overall linkage value in the cumulative-effects analysis area would still be expected to be high due to the small relative amounts of change attributable to any of the action alternatives.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Patch size and shape The proposed activities could result in changes in patch size and shape and cause fragmentation of interior forest habitat.	The average size of dense forest patches is 679 acres in the project area. Of these, 75 percent are larger than 100 acres, and 31.2 miles of edge habitat associated with dense-forest patches exists. In the cumulative-effects analysis area, patch sizes are likely smaller than historic sizes. On DNRC-managed lands, 50 percent of dense forest patches are larger than 100 acres, and 257 miles of edge habitats are associated with dense-forest patches.	***No-Action Alternative A***	
		Patch sizes of dense forest would not decrease, and edge habitats would not increase. No negative and perhaps slight positive effects would be expected to wildlife species that are sensitive to these fragmentation effects.	No cumulative effects to patch sizes of dense forest or edge habitats would be expected.
		Action Alternative B, C, and D	
		Average patch sizes of dense forest would decrease by 48, 66, or 43 percent, respectively. Edge habitats would increase by 15, 13, or 24 percent, respectively, in the project area. All of the action alternatives would be expected to have moderate negative effects to wildlife species that rely on large patches of densely-forested habitat or that are sensitive to edge effects.	The average patch size of dense forest on DNRC-managed lands would decrease by 9.5, 14.5, or 6.3 percent, respectively. Edge habitats would increase 1.2 percent with Action Alternatives B or C, and 3.0 percent with Action Alternative D. These reductions in patch size and increases in edge would be additive to other activities on Swan River State Forest and would cause some slight negative effects to species that prefer large patches of dense-forest habitat or that are negatively affected by edge habitats.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Snag distribution The proposed activities could reduce the number and distribution of snags, which could adversely affect species closely associated with these habitat attributes.	Older stands in the project area and cumulative-effects analysis area have higher densities of snags than were likely present historically, but younger stands are likely below historical densities. Approximately 66 percent of the project area and 56 percent of the cumulative-effects analysis area consist of stands that likely have a high abundance of large snags because of the lack of past harvesting and distance from open roads.	***No-Action Alternative A***	
		Snag densities would not decrease and would likely increase over time, and a diversity of snags would exist. No negative effects and slight long-term positive effects to wildlife species that use snag resources would be expected.	Because additional losses of snags would not occur and the size and species composition would remain diverse in the analysis area, no cumulative effects to wildlife species would be expected.
		Action Alternatives B, C, and D	
		Snag densities would be decreased to a minimum of 2 large snags and 2 snag recruits per acre on 1,187, 1,565, or 1,520 acres, respectively. High densities of snags would be expected to remain on 42, 41, or 47 percent of the project area, respectively. Habitat would be reduced for species that use snag resources, but the overall effects would cause minor negative effects to wildlife in the project area.	Snag densities and diversity would be reduced to low levels (i.e., 2 large snags per acre) on 1,187 to 1,565 acres in addition to other activities in the cumulative-effects analysis area that have affected snag resources. However, under any action alternative, at least 50 percent of the cumulative-effects analysis area would be expected to have high densities of large- and medium-sized snags. Thus, the cumulative effects to wildlife species closely associated with snags are expected to be minor under any action alternative.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Coarse woody debris The proposed activities could reduce the level of coarse woody debris, which could adversely affect species closely associated with these habitat attributes.	Older stands have higher densities of coarse woody debris, and the sizes of these pieces are larger than those found in stands that have been harvested in the last century. Approximately 66 percent of the project area and 56 percent of the cumulative-effects analysis area consist of stands that have not received substantial harvesting and are greater than 200 feet away from roads and, thus, support higher densities of coarse woody debris with many large-diameter materials, as evidenced by the plot data and visual assessments.	***No-Action Alternative A*** Wildlife species that use coarse woody debris would maintain their current amounts of habitat and, over time, gain habitat and/or benefit from improved habitat quality. ***Action Alternatives B, C, and D*** Coarse woody debris would be affected on 1,187, 1,565, or 1,520 acres, respectively. Approximately 15 to 20 tons per acre of coarse woody debris would be left in harvest units, although the materials left may not be as large in diameter as what presently exists. Stands with high densities of large coarse woody debris would remain on 42, 41, or 47 percent of the project area, respectively. In the harvest units, habitat may be removed or the quality may be reduced for species that rely on coarse woody debris, but the overall effects would cause low risk to wildlife species in the project area.	 No negative and slight positive long-term cumulative effects to wildlife species would be expected. Decreases in the amount and/or quality of coarse woody debris could negatively affect wildlife species that rely on these habitat elements. However, under any action alternative, at least 50 percent of the cumulative-effects analysis area would be expected to have high densities of coarse woody debris remaining in stands that have not been harvested or are away from open roads. Any action alternative would likely result in minor cumulative negative effects to wildlife species that use coarse woody debris resources.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Canada lynx The proposed activities would result in the alteration of suitable lynx denning and foraging habitats, rendering them unsuitable for supporting lynx.	Approximately 6,044 acres of lynx habitat occur in the 6,294-acre project area and approximately 9,863 acres of DNRC-managed lands in the cumulative-effects analysis area provide lynx habitats. Much of this habitat was identified as forested travel/ other and mature foraging habitats. The connectivity of forested habitats in the project area is relatively intact.	***No-Action Alternative A***	
		No changes to denning habitat, mature foraging habitat, or connectivity would occur. Young foraging habitats would continue developing; however, long-term decreases in available young foraging habitats would be expected.	
		Action Alternative B	
		401 acres of denning habitats and 556 acres of mature foraging habitats would be removed, with a total of 1,235 acres converted to temporary non-lynx habitats; collectively 1,520 acres of lynx habitat would be affected. Minor connectivity changes would be anticipated. Thus, minor adverse direct and indirect effects would be anticipated.	Denning habitat would be reduced from 16.5 to 12.5 percent of the lynx habitats, and foraging habitats would be reduced from 29.8 to 24.2 percent of the lynx habitats. Temporary nonhabitat would increase from 4.8 to 17.4 percent of the lynx habitats. Minor connectivity changes would be anticipated. Thus, minor adverse cumulative effects would be anticipated.
		Action Alternative C	
		600 acres of denning habitats and 507 acres of mature foraging habitats would be removed, with a total of 1,406 acres converted to temporary non-lynx habitats; collectively 1,565 acres of lynx habitat would be affected. Moderate connectivity changes would be anticipated. Thus, minor adverse direct and indirect effects would be anticipated.	Denning habitat would be reduced from 16.5 to 10.5 percent of the lynx habitats, and foraging habitats would be reduced from 29.8 to 24.7 percent of the lynx habitats. Temporary nonhabitat would increase from 4.8 to 17.4 percent of the lynx habitats. Moderate connectivity changes would be anticipated. Thus, minor adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
		Action Alternative D	
		288 acres of denning habitats and 556 acres of mature foraging habitats would be removed, with a total of 1,053 acres converted to temporary non-lynx habitats; collectively 1,187 acres of lynx habitat would be affected. Minor connectivity changes would be anticipated. Thus, minor adverse direct and indirect effects would be anticipated.	Denning habitat would be reduced from 16.5 to 13.6 percent of the lynx habitats, and foraging habitats would be reduced from 29.8 to 24.2 percent of the lynx habitats. Temporary nonhabitat would increase from 4.8 to 15.5 percent of the lynx habitats. Minor connectivity changes would be anticipated. Thus, minor adverse cumulative effects would be anticipated.
Gray wolf The proposed activities could result in reduced habitat quality on winter range for white-tailed deer and elk, which could lead to reduced prey availability and reduce the potential for the area to support a wolf pack.	Big game species are abundant in the project area and the cumulative-effects analysis area. However, big game winter range is somewhat limited in the project area (110 acres), but much more winter range exists in the cumulative-effects analysis area (3,606 acres).	***No-Action Alternative A***	
		No effects would be expected.	No effects would be expected.
		Action Alternatives B, C, and D	
		Approximately 22 acres of thermal cover and snow intercept would be removed with the proposed gravel pit. No changes to wolf prey numbers would be anticipated despite slight habitat shifts. Minor changes in human disturbance levels during project activities could occur. Thus, negligible adverse direct and indirect effects would be anticipated.	No appreciable change to big game winter range would be anticipated given the limited amount of winter range affected. No changes to wolf prey numbers would be anticipated despite slight habitat shifts. Minor changes in human disturbance levels during project activities could occur. Thus, negligible adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Gray wolf (continued) The proposed activities could result in disturbance of wolves at denning or rendezvous sites, which could lead to pup abandonment and/or increased risk of mortality.	Landscape features commonly associated with denning and rendezvous sites occur in the project area and cumulative-effects analysis area. Although no den or rendezvous sites are known to exist in the project area or cumulative-effects analysis area, 2 areas with centralized locations during the denning period may indicate the presence of a den.	***No-Action Alternative A***	
		No effects would be expected.	No effects would be expected.
		Action Alternative B	
		Proposed units and haul routes exist within a mile of the potential den site; activities could disrupt wolves at den or rendezvous sites, particularly under this alternative. Thus, minor adverse direct and indirect effects would be anticipated.	Proposed units and haul routes exist within a mile of the potential den site. This alternative would have a higher chance of disturbing wolves at these important sites. Thus, negligible adverse cumulative effects would be anticipated.
		Action Alternative C	
		Activities would be the most distant from any known or potential den sites and rendezvous sites. This alternative would have a lower chance of disturbing wolves at these important sites. Thus, minor adverse direct and indirect effects would be anticipated.	Activities would be concentrated in the northern portion of the cumulative-effects analysis area, away from the areas where the Squeezer wolf pack has been spending more time lately and would have a lower chance of disturbing wolves at these important sites. Thus, negligible adverse cumulative effects would be anticipated.
		Action Alternative D	
		Proposed units and haul routes exist within a mile of the potential den site; activities could disrupt wolves at den or rendezvous sites. Thus, minor adverse direct and indirect effects would be anticipated.	Proposed units and haul routes exist within a mile of the potential den site. This alternative would have a higher chance of disturbing wolves at these important sites. Thus, negligible adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Gray wolf (continued) The proposed activities could result in increased human disturbance and the potential for wolf-human conflicts that could alter wolf use of suitable habitats.	Human activities range from high along Swan River to low along the high elevations of Mission Divide. Some open roads exist in the project area and cumulative-effects analysis area; 30.7 percent of the cumulative-effects analysis area exceeds an open-road density of 1 mile per square mile. Roughly 218.8 miles of restricted road occur in the cumulative-effects analysis area. Hiding cover is abundant in the project area (5,728 acres, 91 percent) and cumulative-effects analysis area (9,785 acres, 80 percent).	***No-Action Alternative A***	
		No effects would be expected.	No effects would be expected.
		Action Alternative B	
		No changes would occur in open-road densities. Hiding cover would be reduced on 1,614 acres, and 14 miles of new, restricted roads would be constructed. Thus, minor adverse direct and indirect effects would be anticipated.	No changes in open-road densities would occur. Hiding cover would be reduced by 4.5 percent, and permanent, restricted roads would increase 6.4 percent. Thus, negligible adverse cumulative effects would be anticipated.
		Action Alternative C	
		No changes would occur in open-road densities. Hiding cover would be reduced on 1,734 acres, and 9.5 miles of new, restricted roads would be constructed. Thus, minor adverse direct and indirect effects would be anticipated.	No changes in open-road densities would occur. Hiding cover would be reduced by 4.8 percent, and permanent, restricted roads would increase 4.3 percent. Thus, negligible adverse cumulative effects would be anticipated.
		Action Alternative D	
		No changes would occur in open-road densities. Hiding cover would be reduced on 1,235 acres, and 11.2 miles of new, restricted roads would be constructed. Thus, minor adverse direct and indirect effects would be anticipated.	No changes in open-road densities would occur. Hiding cover would be reduced by 3.4 percent, and permanent, restricted roads would increase 5.1 percent. Thus, negligible adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
Grizzly bear The proposed activities could result in a reduction of hiding cover important for grizzly bears, which could result in: 1) increased displacement of grizzly bears, 2) avoidance of otherwise suitable habitat, and or 3) increased risk of bear-human conflicts.	Hiding cover is abundant in the project area (5,728 acres, 91 percent) and cumulative-effects analysis area (9,785 acres, 80 percent).	***No-Action Alternative A***	
		No effects would be expected.	No effects would be expected.
		Action Alternative B	
		Approximately 1,614 acres of hiding cover would be removed (a 28.2-percent reduction). Thus, minor adverse direct and indirect effects would be anticipated.	Hiding cover would be reduced by 4.4 percent; however, hiding cover would persist on 74.6 percent of the cumulative-effects analysis area. Thus, minor adverse cumulative effects would be anticipated.
		Action Alternative C	
		Approximately 1,734 acres of hiding cover would be removed (a 30.3-percent reduction). Thus, minor adverse direct and indirect effects would be anticipated.	Hiding cover would be reduced by 4.8 percent; however, hiding cover would persist on 74.2 percent of the cumulative-effects analysis area. Thus, minor adverse cumulative effects would be anticipated.
		Action Alternative D	
		Approximately 1,235 acres of hiding cover would be removed (a 21.6-percent reduction). Thus, minor adverse direct and indirect effects would be anticipated.	Hiding cover would be reduced by 3.4 percent; however, hiding cover would persist on 75.6 percent of the cumulative-effects analysis area. Thus, minor adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Grizzly bear (continued) The proposed activities could result in an increase in the density of roads, which could result in an increased displacement of grizzly bears and an increased risk of bear-human conflicts.	Presently, 20.5 percent of the project area and 30.7 percent of the Porcupine Woodward Grizzly Bear Subunit has an open-road density greater than 1 mile per square mile of open road. Approximately 35.4 and 218.8 miles of permanent, restricted roads exist in the project area and cumulative-effects analysis area, respectively.	***No-Action Alternative A***	
		No effects would be expected.	
		Action Alternatives B, C, and D	
		Increases in restricted road would occur, but no changes to open road status or open-road densities would be anticipated. Thus, no direct and indirect effects would be anticipated.	
The proposed activities could result in a decrease in secure areas for grizzly bears, which could result in increased displacement of grizzly bears.	Security habitat currently exists on approximately 27.2 percent of the project area and roughly 25.9 percent of the subunit. Approximately 90.5 percent of the project area and 75.0 percent of the cumulative-effects analysis area exceeds 2 miles per square mile of total-road density. Approximately 3,433 acres (54.5 percent) of the project area exist in the Swan River State Forest Linkage Zone. Nearly 12,844 acres of spring habitat exists in the linkage zone across all ownerships in the cumulative-effects analysis area.	***No-Action Alternative A***	
		No effects would be expected.	No effects would be expected.
		Action Alternative B	
		Security habitat would be reduced from 27.2 to 8.2 percent. Approximately 14 miles of permanent, restricted road would be constructed (a 39.5-percent increase). Roughly 944 acres would be harvested in spring habitats in the linkage zone (27.5 percent of habitats). Thus, low to moderate adverse direct and indirect effects would be anticipated.	No changes to open-road densities would occur. Security habitat would be reduced from 25.9 to 24.1 percent. The percent of the cumulative-effects analysis area with a total road density greater than 2 miles per square mile would increase to 76.5 percent (a 1.5-percent increase). Harvesting on 944 acres of spring habitats in the linage zone would affect 7.3 percent of the spring habitats. Thus, low to moderate adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
		Action Alternative C	
		Security habitat would be reduced from 27.2 to 19.3 percent. Approximately 9.5 miles of permanent, restricted road would be constructed (a 26.8-percent increase). Roughly 1,565 acres would be harvested within spring habitats in the linkage zone (45.6 percent of habitats). Thus, low to moderate adverse direct and indirect effects would be anticipated.	No changes to open-road densities would occur. Security habitat would be reduced from 25.9 to 25.4 percent. The percent of the cumulative-effects analysis area with a total road density greater than 2 miles per square mile would increase to 75.8 percent (a 0.8-percent increase). Harvesting on 1,565 acres of spring habitats in the linage zone would affect 12.2 percent of the spring habitats. Thus, low to moderate adverse cumulative effects would be anticipated.
		Action Alternative D	
		Security habitat would be reduced from 27.2 to 15.7 percent. Approximately 11.2 miles of permanent, restricted road would be constructed (a 31.6-percent increase). Roughly 860 acres would be harvested in spring habitats in the linkage zone (25.1 percent of habitats). Thus, low to moderate adverse direct and indirect effects would be anticipated.	No changes to open-road densities would occur. Security habitat would be reduced from 25.9 to 24.7 percent. The percent of the cumulative-effects analysis area with a total road density greater than 2 miles per square mile would increase to 75.8 percent (a 0.8-percent increase). Harvesting on 860 acres of spring habitats in the linage zone would affect 6.7 percent of the spring habitats. Thus, low to moderate adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Fisher The proposed activities could reduce the amount and/or quality of fisher habitats, which could alter fisher use of the area.	Approximately 3,574 acres of fisher habitat occurs in the upland and riparian areas (3,393 upland acres and 181 riparian acres) in the project area. Much of the riparian areas are preferred fisher covertypes (217 of 304 acres or 72 percent) and much of the preferred fisher covertypes (181 of 217 acres; or 83 percent) are moderately or well-stocked and likely support the structural features necessary for use as fisher resting and denning. Approximately 83.8 percent (420 of 502 acres) of the DNRC-managed acreage in preferred fisher covertypes in the riparian areas in the cumulative-effects analysis area currently supports moderate- to well-stocked densities of sawtimber, which exceeds the 75-percent threshold established in *ARM 36.11.440(1)(b)(i)*. Additionally, in the uplands in the cumulative-effects analysis area, 71.4 percent (5,714 of 7,998 acres) of the DNRC-managed lands in preferred fisher covertypes currently support moderate- to well-stocked densities of sawtimber, indicating potential upland fisher habitats.	***No-Action Alternative A*** No effects would be expected. ***Action Alternative B*** Harvesting would avoid riparian areas, but would reduce or remove upland fisher habitats on 1,200 acres and mature upland stands in preferred covertypes on an additional 12 acres. No changes to motorized human access or trapping mortality potential would be anticipated. Harvesting would reduce snag and coarse woody debris levels. Minor reductions in landscape connectivity would be expected. Thus, minor adverse direct and indirect effects would be anticipated.	***No-Action Alternative A*** No effects would be expected. ***Action Alternative B*** Upland fisher habitats would be reduced on 1,067 acres (a 13.4-percent reduction) but no changes to the riparian habitats would occur and 83.8 percent of preferred fisher covertypes on DNRC-managed lands in riparian areas would meet fisher habitat requirements. Open-road access would not change, but slight increases in snowmobile routes would be expected with the 14 miles of new road construction; therefore, human disturbance and fisher vulnerability to trapping could increase slightly. Minor reductions in landscape connectivity would be expected. Thus, moderate adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Fisher (continued)		***Action Alternative C***	
		Harvesting would avoid riparian areas, but would reduce or remove upland fisher habitats on 1,432 acres and mature upland stands in preferred covertypes on an additional 38 acres. No changes to motorized human access or trapping mortality potential would be anticipated. Harvesting would reduce snag and coarse woody debris levels. Moderate reductions in landscape connectivity would be expected. Thus, moderate adverse direct and indirect effects would be anticipated.	Upland fisher habitats would be reduced on 1,287 acres (a 16.4-percent reduction), but no changes to the riparian habitats would occur and 83.8 percent of preferred fisher covertypes on DNRC-managed lands in riparian areas would meet fisher habitat requirements. Open-road access would not change, but slight increases in snowmobile routes would be expected with the 9.5 miles of new road construction; therefore, human disturbance and fisher vulnerability to trapping could increase slightly. Moderate reductions in landscape connectivity would be expected. Thus moderate adverse cumulative effects would be anticipated.
		Action Alternative D	
		Harvesting would avoid riparian areas, but would reduce or remove upland fisher habitats on 837 acres and mature upland stands in preferred covertypes on an additional 20 acres. No changes to motorized human access or trapping mortality potential would be anticipated. Harvesting would reduce snag and coarse woody debris levels. Minor reductions in landscape connectivity would be expected. Thus, minor adverse direct and indirect effects would be anticipated.	Upland fisher habitats would be reduced on 735 acres (a 9.8-percent reduction), but no changes to the riparian habitats would occur and 83.8 percent of preferred fisher covertypes on DNRC-managed lands in riparian areas would meet fisher habitat requirements. Open-road access would not change, but slight increases in snowmobile routes would be expected with the 11.2 miles of new road construction; therefore, human disturbance and fisher vulnerability to trapping could increase slightly. Minor reductions in landscape connectivity would be expected. Thus, minor adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Pileated woodpecker The proposed activities could reduce suitable nesting and foraging habitat for pileated woodpeckers, which could alter pileated woodpecker use of the area.	In the project area, potential pileated woodpecker nesting habitat exists on approximately 1,651 acres, and another 1,784 acres of sawtimber stands are potential foraging habitats. In the cumulative-effects analysis area, potential pileated woodpecker nesting habitat exists on approximately 2,831 acres (23.1 percent) of DNRC-managed lands, and another 3,602 acres (29.4 percent) of sawtimber stands exist on DNRC-managed lands in the cumulative-effects analysis area that are potential foraging habitats. Additionally, approximately 19,383 acres of adjacent lands provide forested habitats with greater than 40-percent canopy closure, providing stand conditions that could support some pileated woodpecker use.	***No-Action Alternative A***	
		No effects would be anticipated in the near term; in the long term, succession would reduce pileated woodpecker habitats.	
		Action Alternative B	
		Harvesting would modify 631 acres of potential nesting habitats and another 647 acres of potential foraging habitats; total removal would be approximately 1,046 acres (a 30.5-percent reduction) in the project area. Thus, minor adverse direct and indirect effects would be anticipated.	Potential nesting habitat would be reduced to 2,368 acres (a 16.4-percent reduction) and foraging habitats would be reduced to 3,019 acres (a 16.2-percent reduction) on DNRC-managed lands in the cumulative-effects analysis area. Thus, moderate adverse cumulative effects would be anticipated.
		Action Alternative C	
		Harvesting would modify 665 acres of potential nesting habitats and another 773 acres of potential foraging habitats; total removal would be approximately 1,339 acres (a 39.0-percent reduction) in the project area. Thus, moderate adverse direct and indirect effects would be anticipated.	Potential nesting habitat would be reduced to 2,211 acres (a 21.9-percent reduction) and foraging habitats would be reduced to 2,883 acres (a 19.7-percent reduction) on DNRC-managed lands in the cumulative-effects analysis area. Thus, moderate adverse cumulative effects would be anticipated.
		Action Alternative D	
		Harvesting would modify 411 acres of potential nesting habitats and another 543 acres of potential foraging habitats; total removal would be approximately 872 acres (a 25.4-percent reduction) in the project area. Thus, minor adverse direct and indirect effects would be anticipated.	Potential nesting habitat would be reduced to 2,469 acres (a 12.8-percent reduction) and foraging habitats would be reduced to 3,092 acres (a 14.2-percent reduction) on DNRC-managed lands in the cumulative-effects analysis area. Thus, minor adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Big game The proposed activities could remove forest cover on important winter ranges, which could lower their capacity to support white-tailed deer and elk.	White-tailed deer are abundant in both the project area and cumulative-effects analysis area. Winter range exists on 110 acres of the project area and 3,606 acres of the cumulative-effects analysis area.	***No-Action Alternative A***	
		No effects would be anticipated.	No effects would be anticipated.
		Action Alternatives B, C, and D	
		No harvesting would occur on the winter range; however, 22 acres would be removed with the proposed gravel pit. Thus, minor adverse direct and indirect effects would be anticipated.	Negligible displacement of wintering white-tailed deer would be expected; however, thermal cover and snow intercept would be reduced by 0.6 percent. Thus, minor adverse cumulative effects would be anticipated.
The proposed activities could remove elk security cover, which could affect hunter opportunity and the quality of local recreational hunting.	Approximately 4,505 acres of the project area are part of a larger patch of security habitat. In the cumulative-effects analysis area, a 17,778-acre forested patch (47.3 percent of the cumulative-effects analysis area) meets the distance, cover, and size requirements of elk security across ownerships.	***No-Action Alternative A***	
		No effects would be anticipated.	No effects would be anticipated.
		Action Alternative B	
		No changes in open-roads or motorized access would occur. Increases in nonmotorized access would be possible with the 14 miles (a 39.5-percent increase) of permanent, restricted road to be built. Elk security habitat would be reduced by 1,006 acres (a 22.3-percent reduction) and altered on another 216 acres (4.8 percent). Thus, minor adverse direct and indirect effects would be anticipated.	No changes in open-roads or motorized access would be anticipated. Minor increases in nonmotorized access could occur with the 14 miles of permanent, restricted road to be built. Project-level alterations of cover would reduce 5.7 percent of existing security habitat and reduce to 44.6 percent the overall amount of the cumulative-effects analysis area that is providing security habitat. Thus, minor adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
WILDLIFE (CONTINUED)			
Big game (continued)		***Action Alternative C***	
		No changes in open roads or motorized access would occur. Increases in nonmotorized access would be possible with the 9.5 miles (a 26.8-percent increase) of permanent, restricted road to be built. Elk security habitat would be reduced by 1,106 acres (a 24.6-percent reduction) and altered on another 142 acres (3.2 percent). Thus, minor adverse direct and indirect effects would be anticipated.	No changes in open roads or motorized access would be anticipated. Minor increases in nonmotorized access could occur with the 9.5 miles of permanent, restricted road to be built. Project-level alterations of cover would reduce 6.2 percent of existing security habitat and reduce to 44.3 percent the overall amount of the cumulative-effects analysis area that is providing security habitat. Thus, minor adverse cumulative effects would be anticipated.
		Action Alternative D	
		No changes in open roads or motorized access would occur. Increases in nonmotorized access would be possible with the 11.2 miles (a 31.6-percent increase) of permanent, restricted road to be built. Elk security habitat would be reduced by 901 acres (a 20.0-percent reduction) and altered on another 132 acres (2.9 percent). Thus, minor adverse direct and indirect effects would be anticipated.	No changes in open roads or motorized access would be anticipated. Minor increases in nonmotorized access could occur with the 11.2 miles of permanent, restricted road to be built. Project-level alterations of cover would reduce 5.1 percent of existing security habitat and reduce to 44.9 percent the overall amount of the cumulative-effects analysis area that is providing security habitat. Thus, minor adverse cumulative effects would be anticipated.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
GEOLOGY AND SOILS			
Compaction and displacement Traditional ground-based harvesting operations have the potential to compact and displace surface soils, which reduces hydrologic function, macro-porosity, and soil function.	The majority of the proposed activities would harvest previously unentered stands. Historic harvest units in the project area would continue to recover from past soil impacts through the natural amelioration processes.	***No-Action Alternative A***	
		No direct or indirect effects to soil physical properties would occur under this alternative. Soil conditions within historic harvested units would continue to naturally ameliorate.	
		Action Alternative B	
		10.1 to 19.5 percent of the soils resource in the project area would be impacted by log skidding, equipment operation, gravel-source development, and new road construction.	In 3 separate harvest units that had past management activities since the 1960s a total of 7.7 acres would be reentered. Due to mitigations and BMPs that would be applied in these areas and the relatively small amount of acres that would be reentered, the risk and impact of cumulative effects to soil physical properties is low.
		Action Alternative C	
		8.5 to 18.7 percent of the soils resource in the project area would be impacted by log skidding, equipment operation, gravel-source development, and new road construction.	In 5 separate harvest units that had past management activities since the 1960s a total of 39.4 acres would be reentered. Due to the mitigations and BMPs that would be applied in these areas and the relatively small amount of acres that would be reentered, the risk and impact of cumulative effects to soil physical properties would be low.
		Action Alternative D	
		10.1 to 19.3 percent of the soils resource in the project area would be impacted by log skidding, equipment operation, gravel-source development, and new road construction.	In 2 separate harvest units that had past management activities since the 1960s a total of 3.3 acres would be reentered . Due to the mitigations and BMPs that would be applied in these areas and the relatively small amount of acres that would be reentered, the risk and impact of cumulative effects to soil physical properties would be low.

<table>
<tr><th>RESOURCE ISSUE</th><th>EXISTING ENVIRONMENT</th><th>DIRECT AND INDIRECT EFFECTS</th><th>CUMULATIVE EFFECTS</th></tr>
<tr><td colspan="4">GEOLOGY AND SOILS</td></tr>
<tr><td rowspan="4">Erosion

Harvesting operations have the potential to increase erosion of the productive surface soils in harvest units and move them offsite.</td><td rowspan="4">No features with chronic erosion were observed in either proposed or historic harvest units in the project area.</td><td colspan="2">No-Action Alternative A</td></tr>
<tr><td colspan="2">No additional sites of erosion would be created.</td></tr>
<tr><td colspan="2">Action Alternatives B, C, and D</td></tr>
<tr><td>The potential for upland erosion and transport in actual harvest units would be low based on field observation of past projects and DNRC-monitoring data.</td><td>No historical managed sites in the project area were observed to contain chronic erosion features. All past impacted sites have revegetated naturally and have returned or are returning to their natural base erosion rates. No cumulative effects from erosion in the analysis area are expected.</td></tr>
<tr><td rowspan="4">Soil productivity
Harvesting activities associated with the proposed actions may cumulatively affect long-term soil productivity.</td><td rowspan="4">No harvest units in the project area have matured to an age suitable for a second rotation harvest. A very small percent of the project area would be reentered.</td><td colspan="2">No-Action Alternative A</td></tr>
<tr><td>Site productivity would continue to improve within historic harvest units and would remain stable or possibly decrease in unmanaged stands.</td><td>No new impacts to the soils resources would be expected and soil productivity trends would continue on a stable to upward trend, resulting from continual amelioration of past soil impacts. Soil productivity may possibly decrease in unmanaged stands.</td></tr>
<tr><td colspan="2">Action Alternatives B, C, and D</td></tr>
<tr><td>Proposed activities would have moderate impacts for a short duration (15 to 20 years) to site nutrient pools and site productivity.</td><td>Due to the small amount of acres proposed for reentry under this alternative, information gained from past harvesting, and levels of coarse and fine woody debris that would be retained for nutrient cycling, a low risk of low-level impacts to long-term soil productivity would be expected.</td></tr>
</table>

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
GEOLOGY AND SOILS (CONTINUED)			
Slope stability Activities associated with the proposed actions, such as timber harvesting and road construction, have the potential to affect slope stability through increased water yields and road surface drainage concentration, resulting in the exceedence of resisting forces.	Only 1 small slope failure was documented during field review of the project area. Areas prone to slope instability are present in the project area, but minimal activities are planned for those locations.	***No-Action Alternative A***	
		No direct or indirect effects to slope stability would occur relative to natural background erosional and landslide frequency rates.	
		Action Alternative B	
		A moderate risk exists for the proposed activities to increase the risk of slope instability for a short period of time both during and after project implementation.	8.5 percent of the transportation system has been built or is planned to be built on a map unit prone to slope instability. Due to the short length of new construction and the lack of field observation of mass movements on this unit, the risk of cumulative effects to slope stability from road construction activities are expected to be low.
		Action Alternative C	
		A low risk exists for the proposed action to increase the risk of slope instability during and after project implementation.	Less than 1 percent of the transportation system has been built or is planned to be built on a map unit prone to slope instability. Due to the short length of new construction and the lack of field observation of mass movements on this unit, the risk of cumulative effects to slope stability from road construction activities is low.
		Action Alternative D	
		A moderate risk exists for the proposed action to increase the risk of slope instability for a short period of time both during and after project implementation.	8.4 percent of the transportation system has been built or is planned to be built on a map unit prone to slope instability. Due to the short length of new construction and the lack of field observation of mass movements on this unit, the risk of cumulative effects to slope stability from road construction activities would be low.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
GEOLOGY AND SOILS (CONTINUED)			
Long-term productivity The removal of large volumes of both coarse and fine woody material through timber harvesting reduces the amount of organic matter and nutrients available for nutrient cycling, possibly affecting the long-term productivity of the site.	Historic harvested units contain lower levels of nutrient pools represented by both coarse and fine woody debris. Unentered stands that were surveyed mimic the volumes both observed and recommended by the scientific community.	***No-Action Alternative A*** Nutrient pools would continue to recover in historic harvested units and would continue on a stable trend in unmanaged stands in the project area. ***Action Alternatives B, C, and D*** The volume of coarse and fine woody material retained on site would vary by habitat type and sivilcultural objective, but would typically range from 15 to 25 tons per acre (*Graham et al. 1994*).	 A low risk exists of cumulative effects to nutrient pools in the reentered stands. Stands that contain adequate levels of both fine and coarse woody material would have slash-management prescriptions to maintain a stable nutrient cycling trend.
ECONOMICS			
The proposed action may affect revenue generated for the Common School Trust, funding for FI projects, timber-related employment, and revenue generated in the regional economy.	Lake, Flathead, and Missoula counties have active, compact forest industries. Industry gross income in these counties ranges between $1 and $12 million annually. Timber revenue distributed to public schools has declined recently due to poor lumber markets.	***No-Action Alternative A*** No effects are anticipated. ***Action Alternative B*** Action Alternative B would produce $1,588,477 in trust land revenue, 215 industry jobs, and $8.7 million in timber industry earnings. ***Action Alternative C*** Action Alternative C would produce $1,949,598 in trust land revenue, 242 industry jobs, and $9.9 million in timber industry earnings. ***Action Alternative D*** Action Alternative D would produce $1,148,446 in trust land revenue, 155 industry jobs, and $6.3 million in timber industry earnings.	 No effects are anticipated. The cumulative effects of these proposed actions are the continued financial contribution to public education in Montana and the continued contribution of volume to the state land annual sustained yield. The cumulative effects of these proposed actions are the continued financial contribution to public education in Montana and the continued contribution of volume to the state land annual sustained yield. The cumulative effects of these proposed actions are the continued financial contribution to public education in Montana and the continued contribution of volume to the state land annual sustained yield.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
AIR QUALITY			
Smoke Smoke produced from prescribed burning associated with the proposed action may adversely affect local air quality.	Air quality in the analysis area is generally excellent and has limited local emission sources and consistent wind dispersion throughout most of the year. Emissions do not affect local population centers, impact zones, or Class I Areas beyond EPA and DEQ standards.	***No-Action Alternative A*** No effects are anticipated. ***Action Alternatives B, C, and D*** Burning days would be controlled and monitored by DEQ and the smoke monitoring unit of the Montana/Idaho Airshed Group and would meet EPA standards; thereby, the direct and indirect effects of burning activities would be minimized.	***No-Action Alternative A*** No effects are anticipated. ***Action Alternatives B, C, and D*** Cumulative effects to air quality are not expected to exceed EPA and DEQ standards.
Dust Dust produced from road construction, road maintenance, harvest-related traffic, and gravel-pit development and operations associated with the proposed action may adversely affect local air quality.		***No-Action Alternative A*** No effects are anticipated. ***Action Alternatives B, C, and D*** Direct and indirect effects to air quality are expected to be localized to the roadways, areas directly adjacent to the roadways, and the southern portion of Section 24, T23N, R18W. Vegetative barriers and abatement measures are expected to greatly limit the dispersion of particulate matter beyond those areas.	***No-Action Alternative A*** No effects are anticipated. ***Action Alternatives B, C, and D*** Cumulative effects to air quality are not expected to exceed EPA and DEQ standards.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
Recreation			
Activities associated with the proposed action may affect recreational uses in the area and the subsequent revenue generated by such uses. The recreational uses of particular concern include public motorized use, hunting, and other public nonmotorized uses.	Several miles of road open, seasonally restricted, and closed to public motorized access exist throughout the area. Big game species are currently abundant throughout both analysis areas, affording many hunting opportunities. Ongoing forest-management activities temporarily displace recreationists to areas free of management. Revenue is generated by a number of recreational licenses throughout the area.	***No-Action Alternative A***	
		No effects are anticipated.	No effects are anticipated.
		Action Alternatives B, C, and D	
		No changes in open roads or motorized access would occur. A 15- to 23-percent increase in road miles would be available for public nonmotorized recreation. No adverse direct or indirect effects to hunting are expected. As a result of forest-management activities, direct and indirect effects to recreationists during the work week are expected to be moderate to high, while direct and indirect effects to those who recreate during the weekend are expected to be minimal. No changes in revenue-producing recreational licenses are expected.	Cumulative effects would result in increases in nonmotorized public access and further displacement of recreationists from active harvesting areas during typical business hours. Adverse cumulative effects are expected to be minor since recreationists would continue to have recreational opportunities throughout inactive subunits.
AESTHETICS			
Views Activities associated with the proposed action may affect visual quality as seen from specific observation points in the area.	Several acres previously harvested and road miles are potentially visible from specific observation points, yet currently are inhibited by existing vegetative barriers in the foreground. The existing landscape has various modifications of vegetative textures, forms, lines, and colors affecting the visual quality of the area.	***No-Action Alternative A***	
		No effects are anticipated.	No effects are anticipated.
		Action Alternatives B, C, and D	
		Increases in the amount of visible acres and road miles would be negligible due to obstructions in the foreground and middleground of each observation point. Most visible acres from the observation points would appear relatively stark in contrast when adjacent to regenerating or unharvested stands.	The contribution of visible harvested acres and new road miles under each action alternative as seen from each observation point would be minor in comparison to what exists currently throughout the landscape.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
AESTHETICS			
Noise levels Activities associated with the proposed action may affect local noise levels.	Traffic, harvesting operations, rock blasting, and gravel crushing all produce noise throughout the area. Noise generated from these activities coincides with the rotational schedule required under the SVGBCA.	***No-Action Alternative A***	
		No effects are anticipated.	No effects are anticipated.
		Action Alternatives B, C, and D	
		Direct and indirect effects to noise levels as a result of harvesting operations, harvest-related traffic, and gravel-pit development associated with the action alternatives are expected to be moderate during the work week and minor during the weekend.	Except during periods of rock blasting and gravel crushing, cumulative effects to noise would not be expected to increase beyond current levels found in the cumulative-effects analysis area.

WHITE PORCUPINE MULTIPLE TIMBER SALE PROJECT
CHAPTER III
EXISTING ENVIRONMENT AND
ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter is a summary of resource conditions as they relate to the proposed White Porcupine Multiple Timber Sale Project. The current, or existing, condition can be viewed as a baseline to compare changes resulting from the selection of any alternative. How each alternative may affect the environment is also described. For more complete assessments and analyses related to the resources for both scientific and judicial review, refer to the appropriate section of this DEIS.

INTRODUCTION

This analysis describes current vegetative conditions on Swan River State Forest and discloses the potential direct, indirect, and cumulative environmental effects that may result under each alternative associated with the proposed action.

ISSUES AND MEASUREMENT CRITERIA

Issues regarding the effects of harvesting activities upon the various vegetation components were identified through public and internal scoping. These issues are listed in *TABLE I-1 - ISSUES STUDIED IN DETAIL* and are reiterated at the beginning of each topic section (covertype, age class, etc). Various measurement criteria were utilized to evaluate the effects of the alternatives, depending on the vegetative component. The criteria used for evaluation are described under *ANALYSIS AREAS* and *ANALYSIS METHODS,* below.

ANALYSIS AREAS

Direct and Indirect Effects

The analysis area for the direct and indirect effects was examined at the nested scales of the entire Swan River State Forest and the White Porcupine Multiple Timber Sale Project Area *(*see *PROJECT AREA MAP* located before Chapter I*)*.

Considering effects at each nested scale is important because activities within 1 scale can influence all scales and effects at 1 scale may be unapparent or misleading in representation of effects at another scale.

Cumulative Effects

The analysis area used to assess cumulative effects includes all ownerships within the perimeter of Swan River State Forest. Lands adjacent to or within the perimeter of Swan River State Forest, such as the U.S. Forest Service (USFS); private, noncommercial, and Plum Creek will be addressed to the extent possible. While DNRC does not have adequate data to quantitatively discuss conditions or ownership changes on other lands in the analysis area, we acknowledge that management actions on these other lands can have ecological effects to resources on DNRC-managed lands; thus, these effects will be discussed qualitatively.

ANALYSIS METHODS

Effects to forest vegetation are described and analyzed in terms of covertype representation, age-class distributions, old-growth amounts and attribute levels, patch dynamics, forest fragmentation, stand structure and vigor, crown cover, fire effects, the role of insects and diseases, sensitive plants, and noxious weeds. Specific methods used to analyze each of those attributes are further described in the following effects analyses.

Direct and Indirect Effects

Direct and indirect effects analyses for both the entire Swan River State Forest and the project-level analysis area are present throughout the DEIS. Much of the analysis uses data from the SLI. The SLI quantifies stand characteristics for all forest stands in Swan River State Forest and is incorporated into DNRC's Geographic Information System (GIS). The SLI is updated annually to account for harvesting activities and periodically through reinventory. This process provides DNRC foresters with current data for use in analyses of proposed management activities.

Volume information for the majority of the stands proposed for treatment was collected during a pretimber sale cruise in November 2007. This data was used to develop estimates of final harvest volumes and residual stand conditions. During the cruise, DNRC personnel also made ocular verification of the old-growth status.

The Forest Management Rules *(36.11404 ARM)* direct DNRC to take a coarse-filter approach to biodiversity. To promote biodiversity, an appropriate mix of stand structures and compositions on State land should be favored (*Montana DNRC 1996).* The coarse-filter approach utilizes landscape-analysis techniques to determine an appropriate mix of stand structures and compositions for Swan River State Forest based on ecological characteristics such as landtypes, climatic sections, habitat types, disturbance regimes, and other unique characteristics.

The analysis of stand development would be a qualitative discussion of the conditions of timber stands, including how various natural and man-caused disturbances and site factors have affected, and may continue to affect, timber-stand development. Project-level and cumulative effects to forest vegetation are described and analyzed in terms of covertype representation, age class distributions, old-growth amounts and attribute levels, patch dynamics, forest fragmentation, stand structure and vigor, crown cover, fire effects, the roles of insects and diseases, sensitive plants, and noxious weeds.

Cumulative Effects

Since ongoing and future timber sales have not undergone postharvest inventory, probable effects of these sales are taken into consideration in order to address cumulative effects under each analysis section. The timber sales listed in *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* under *SCOPE OF THIS EIS* in *CHAPTER I* were considered along with the SLI database.

Activities upon adjacent lands, such as USFS, private, noncommercial, and Plum Creek, will also be addressed to the extent possible under cumulative effects.

BACKGROUND INFORMATION

PAST MANAGEMENT

The first known harvest in Swan River State Forest took place in the early 1900s. All residual signs of the activities indicate that the harvest was very minimal in scope and acreage. Timber harvesting on a larger scale began in and adjacent to the project area during the 1960s. Most of the harvesting in the 1960s were regeneration harvests on 20-acre units and occurred in the flatter areas at the base of the Mission Range. Seedtree and clearcut harvesting between 1970 and 1992 have created 10- to 150-acre openings with dense regeneration. Signs of individual tree-selection harvests, skid trails, and stumps from logging that took place in the era from the 1960s to the 1980s are scattered throughout many of the stands. Limited salvage has taken place in the project area since the 1990s, with several permits having been completed in the areas immediately adjacent to the project area. The South Woodward Timber Sale Project during 2001 through 2004 was the last large timber sale in the project area. According to the SLI, the majority of the stands (53.7 percent) in the project area have been entered at some point in the past.

Most previously harvested stands have regenerated successfully, either naturally or by planting, and are dominated by western larch, lodgepole pine, rust-resistant western white pine, and in some areas, ponderosa pine. Most of the stands have also retained a minor component of grand fir, subalpine fir, Douglas-fir, western red cedar, and Engelmann spruce. Many units are slated for precommercial thinning under the Woodward Pointed Face Precommercial Thinning Project.

Plum Creek and other privately held lands adjacent to the project area have been harvested to various extents by utilizing various harvest treatments; these lands include Sections 23, 25, 27, and 35, T24N, R18W, and Sections 1, 3, 9, 11, 13, 15, 17, 21, 25, 27, 29, 33, and 35, T23N, R18W. Many of these harvests have created abrupt straight edges that follow section line ownership boundaries.

ELEVATION AND ASPECT

Elevation and aspect interact to influence the tree and shrub species potentially present in a stand, as well as to influence successional pathways and the percent of ground cover. The project area ranges in elevation from 3,200 to 6,200 feet. A large portion of the project area has a south-to-east-to-northeast aspect, resulting in sites that are wetter and cooler than those on south- or west-facing aspects. Cooler, wetter stands typically develop overstories of western white pine, western larch, Douglas-fir, grand fir, western red cedar, Engelmann spruce, lodgepole pine, and subalpine fir.

The majority of the old-growth stands proposed for harvesting are on north to east aspects in the low- to mid-elevation zone, between 3,200 and 5,000 feet. Treatments for these particular stands vary depending on the aspect and elevation and the influence these would have on regeneration. The north-to-east aspect sites receive less sunlight than their south-to-west aspect counterparts and tend to have wetter, cooler soils. Due to these sites being wetter and cooler, seedtree treatments would generally be proposed for these aspects.

STAND DEVELOPMENT

Natural processes of stand development and disturbance are influenced by environmental conditions and site characteristics, such as soils, stand covertype, forest health, elevation, aspect, climate, and stand structure. Stand structures and species composition can be greatly modified by natural disturbances, such as wildfire and blowdown. In the absence of natural or human-caused disturbances, stands continue to progress along a successional path, resulting in shifting species composition through time. This process is known as succession. Disturbance interrupts the progression of a stand along a successional path and generally creates conditions favorable to shade-intolerant species, such as western larch. As such, shade-intolerant species typically dominate the early stages of stand development, and in the absence of disturbance, shade-tolerant species typically dominate the later stages of stand development.

As an illustration of succession, consider a stand of western larch and Douglas-fir that established following a fire. As these trees grow and the canopy in the stand closes, conditions more favorable to shade-tolerant species would be created and the stand would begin to develop an increasingly dense understory of grand fir and other shade-tolerant species. Eventually, the shade-tolerant species, which can compete more effectively than small western larch or Douglas-fir growing in shaded conditions, would advance into the upper layers of the canopy and dominate the stand; thus, the stand would shift from a western larch/ Douglas-fir covertype to a mixed-conifer covertype.

A more complex example of shade-tolerant species replacing less-tolerant species can be seen in the western white pine stands on Swan River State Forest. Western white pine has a relatively limited range in Montana compared to many other species due to its requirement for moister growing sites than are typically found across much of the State. As such, Swan Valley is an important area for western white pine in Montana. Western white pine is intermediate in its shade-tolerance, meaning that it can establish and grow under semi-shaded conditions, but favors more open, sunlit conditions (*Haig et al. 1941*). Western white pine stands are typically even-aged and develop as a result of stand-replacing wildfires (*Boyd 1980, Graham 1990*). However, western white pine is also adapted to survive low-intensity ground fires that would kill thin-barked species such as grand fir (*Arno and Hammerly 2007*). Fires would expose bare mineral soil, which western white pine favors for germination (*Graham 1990*), and because of its fast growth, western white pine could often easily outgrow its competitors on such sites. Under these disturbance regimes, western white pine would be able to perpetuate itself on the landscape.

While lack of disturbance due to fire suppression has limited western white pine, a nonnative disease, white pine blister rust, which was introduced into the Inland Northwest in 1910, has also played a major role in western white pine's demise. Blister rust causes a canker to develop on the stem of the tree that eventually girdles and kills the tree. All 5-needle pines, including western white pine, are susceptible to blister rust, although some individual trees appear to exhibit natural resistance to the disease.

Lack of disturbance events, on which the western white pine is dependent, and the effects of blister rust have worked in concert to decrease the presence of western white pine stands on the landscape. Blister rust kills not only mature western white pine, but also young, regenerating western white pine, resulting in that component being lost in both mature stands and young stands. The loss of mature western white pine also removes from the landscape the seed source for future western white pine stands. The lack of disturbance on which western white pine depends inhibits the few western white pine that have not succumbed to blister rust by promoting conditions favorable to the development of shade-tolerant species, resulting in increases in the mixed-conifer covertype. Without treatments that conserve naturally resistant western white pine and emulate the disturbance regime with which western white pine evolved, the likelihood of maintaining western white pine stands on the landscape is diminished.

Many of the stands proposed for harvesting in the project area have one of these successional patterns occurring. Proposed treatments would attempt to emulate naturally occurring disturbance patterns and, in most cases, would retain stands in, or return stands to, earlier stages of succession dominated by seral species.

HABITAT TYPES

Site factors, such as soil type, aspect, elevation, growing season, and moisture availability, are combined to develop classifications of habitat types, which are then used to describe potential successional development and site productivity, among other things (*Pfister et al. 1977).* Habitat-type classifications rely on the premise that understory plant communities are more stable than overstory plant communities and, as such, serve as better indicators of potential productivity and successional development on a site. Because habitat types describe potential vegetation, which is not necessarily the same as the current overstory vegetation, they do not change following disturbance, including timber harvesting.

While differences in plant communities and site productivity exist among similar habitat types, many share similar naturally occurring disturbance patterns, such as the way fire behaves and affects those habitat types, and, as such, can be arranged into broad groups *(Fischer and Bradley 1987).* In the project area, 78 percent of the area is categorized as belonging to the warm, moist, grand fir, western red cedar, and western hemlock habitat-type group. As these stands progress through successional stages, the mixed-conifer covertype would become more dominant. The moist, low-elevation subalpine fir habitat-type group occurs on 22 percent of the area.

The stands proposed for harvesting are included in both the warm and moist grand fir, cedar, hemlock, and the moist, low-elevation subalpine fir habitat-type groups. Typically, these groups have relatively high timber production, regenerate best with more intensive management treatments, and provide great opportunities for seral species. *TABLE V-1 – ACRES TREATED PER HARVEST PRESCRIPTION BY HABITAT TYPE GROUP* shows the amount of acres being treated within these habitat-type groups by harvest prescription.

TABLE V-1 – ACRES TREATED PER HARVEST PRESCRIPTION BY HABITAT TYPE GROUP

ACTION ALTERNATIVE	HARVEST PRESCRIPTION	HABITAT TYPE GROUPS		
		WARM AND MOIST	MOIST, LOW ELEVATION SUBALPINE	TOTALS
B	Seedtree	572	113	685
	Seedtree with reserves	383	95	478
	Shelterwood with reserves	71	0	71
	Variable thin	183	102	285
C	Seedtree	711	78	789
	Seedtree with reserves	461	0	461
	Shelterwood	29	0	29
	Shelterwood with reserves	124	0	124
	Variable thin	79	81	160
D	Seedtree	291	129	420
	Seedtree with reserves	383	95	478
	Shelterwood	29	0	29
	Shelterwood with reserves	124	0	124
	Variable thin	33	102	135

COVERTYPE

Issue: The proposed activities may affect forest covertypes through species removal or changes in species composition.

EXISTING ENVIRONMENT

Covertypes describe the species composition of forest stands. Covertype representation often varies according to the frequency of disturbances. Some seral species-dominated types, such as ponderosa pine, reflect a frequent low-intensity disturbance that helps perpetuate the shade-intolerant ponderosa pine. Other types, such as the mixed-conifer type, reflect an absence of disturbance, indicating stands further along the successional pathway dominated by shade-tolerant species.

The protocol used to assign covertypes on DNRC-managed forest lands, including Swan River State Forest, is explained in detail in the Forest Management Rules *(36.11401* through *406 ARM).* The methods used to analyze current and appropriate stand conditions are described below.

This covertype analysis compares historic forest conditions, desired future conditions, and current stand conditions in terms of forest species composition. Tracking expected changes in the amount of preharvest and postharvest acreage in specific covertypes helps to describe project effects to forest vegetation and track movement toward or away from desired future conditions. Where appropriate, the climatically- and physiographically-defined "Upper Flathead Section" (*M333C*) of the larger, vegetation-defined "Northern Rocky Mountain Forest-Steppe-Coniferous Forest–Alpine Meadow Province" (*Provence M333*) (*Bailey et al. 1994*) was utilized as a reference for the historical conditions in Swan River State Forest and the project area. Historic conditions of age classes and covertypes were quantified by *Losensky (1997*), who used forest inventory data from the 1930s to estimate the historic proportion of age classes by forest covertype for Montana. This provided an estimate of age-class distribution and stand composition prior to Euro/American settlement and the effects of fire suppression, selective logging, cattle and sheep grazing, and the full impact of white pine blister rust. Current conditions and desired future conditions are defined using DNRC's site-specific SLI.

Two data filters were developed to assign covertypes in a manner similar to that used in the 1930s inventory and applied to the Swan River State Forest SLI data *(swn sliswnc20050513 and swn_sli20060928)*. The first, representing current conditions, followed the 1930s as closely as possible. The second, representing desired future conditions, assigned covertypes using criteria to address situations where the current type may not be representative of desired conditions, such as stands where succession from one covertype to another was occurring. The desired future condition filter indicated that those areas where fire suppression occurred, pathogens were introduced, and timber was harvested would likely have been assigned to a different covertype than the current covertype filter suggests. The filter for desired future conditions provides an assessment for the proportion of various covertypes that would likely have existed under average historic conditions.

FIGURE V-1 – PROPORTION OF HISTORIC CONDITIONS (1930s) BY COVERTYPE FOR SWAN RIVER STATE FOREST, FIGURE V-2 – CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOREST, and *FIGURE V-3 – DESIRED FUTURE CONDITION BY COVERTYPE ON SWAN RIVER STATE FOREST* illustrate the proportion of forest occupied by various covertypes at differing scales and time periods. *FIGURE V-1* shows the historical proportional representation of covertypes for Swan River State Forest. Results within *FIGURES V-2* and *V-3*, and *TABLE V-2- CURRENT COVERTYPE AND DESIRED FURTURE CONDITIONS FOR SWAN RIVER STATE FOREST AND THE PROJECT AREA* indicate that mixed-conifer stands are currently overrepresented compared to historic data and desired future conditions. Many of the species that compose mixed-conifer stands are shade tolerant and increase in density as the intervals between disturbances, such as wildfires, increase.

In reference to desired future condition, the western larch/Douglas-fir and western white pine covertypes are currently underrepresented on Swan River State Forest, but for different reasons. Western larch and Douglas-fir are preferred timber species that were often removed by partial or selective harvest methods that failed to provide suitable conditions for regenerating the species. Western larch/Douglas-fir stands have historically been perpetuated through fairly intensive disturbances, such as wildfires, and because, when mature, they are more resistant to fire mortality than other species, some individuals would survive a natural disturbance and provide a seed source for subsequent regeneration. The lack of natural disturbances has prevented the regeneration of western larch across much of Swan River State Forest, particularly in the dense old stands common throughout the project area, and has resulted in a shift in dominance from the shade-intolerant species like western larch and Douglas-fir toward

FIGURE V-1 – PROPORTION OF HISTORIC CONDITIONS (1930s) BY COVERTYPE FOR SWAN RIVER STATE FOREST

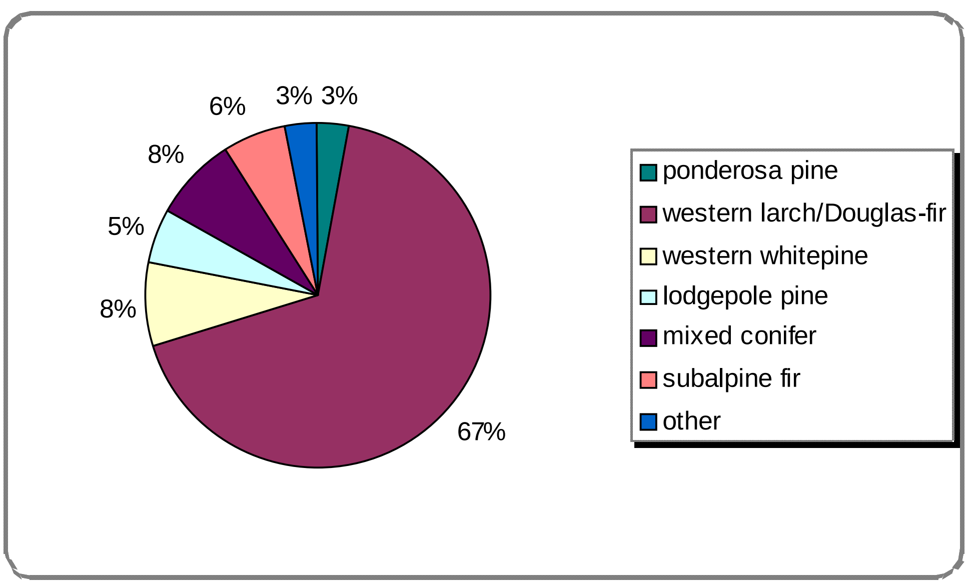


FIGURE V-2 – CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOREST

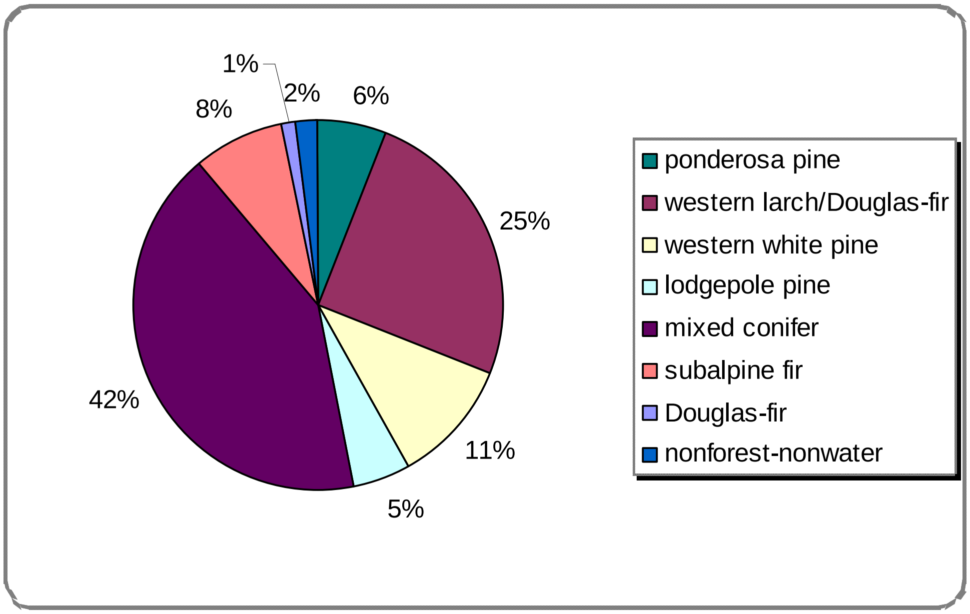


FIGURE V-3- DESIRED FUTURE CONDITION BY COVERTYPE ON SWAN RIVER STATE FOREST

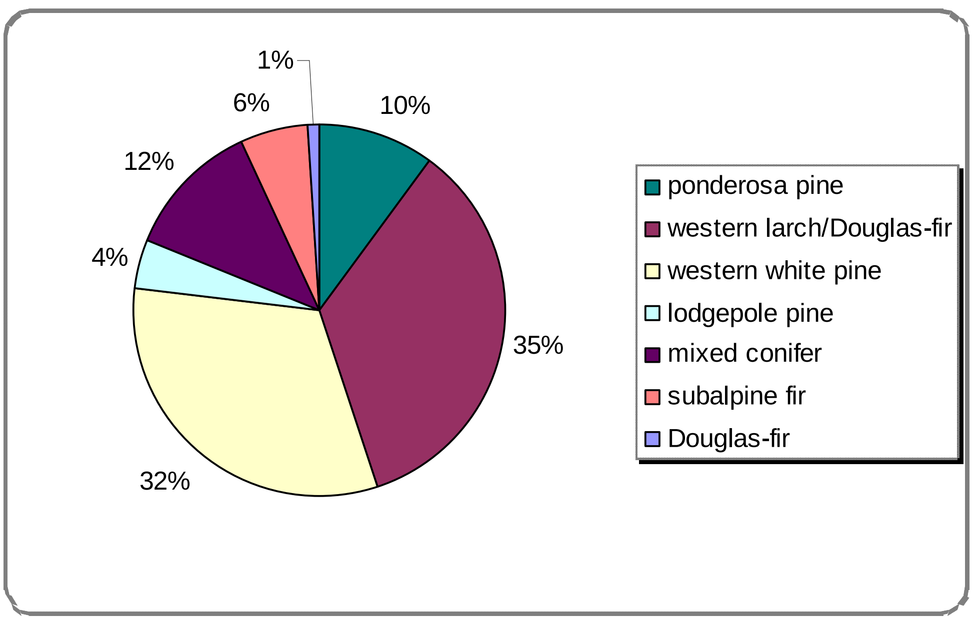


TABLE V-2 - CURRENT COVERTYPE AND DESIRED FUTURE CONDITIONS – SWAN RIVER STATE FOREST AND THE PROJECT AREA

COVERTYPE	CURRENT (ACRES)	PERCENT OF TOTAL	DESIRED FUTURE CONDITION (ACRES)	PERCENT OF TOTAL	*DIFFERENCE (PERCENT)*
SWAN RIVER STATE FOREST					
Ponderosa pine	2,406	6.1	2,063	5.2	*-0.9*
Douglas-fir	537	1.4	571	1.4	*0.1*
Western larch/ Douglas-fir	9,737	24.5	16,044	40.4	*15.8*
Western white pine	4,236	10.7	10,181	25.6	*14.9*
Lodgepole pine	2,054	5.2	1,609	4.0	*-1.1*
Mixed conifer	15,800	39.8	5,209	13.1	*-26.7*
Subalpine fir	3,256	8.2	2,849	7.2	*-1.0*
Nonforested/Nonwater	908	2.3	1,189	3.0	*0.7*
Nonstocked	718	1.8	0	0.0	*-1.8*
Hardwoods	36	0.1	21	0.1	*0.0*
Totals[1]	*39,688*	*100.0*	*39,736*	*100.0*	
WHITE PORCUPINE PROJECT AREA					
Ponderosa pine	21	0.3	0	0.0	*-0.3*
Douglas-fir	14	0.2	63	1.0	*0.8*
Western larch/ Douglas-fir	954	15.3	2,716	43.9	*28.6*
Western white pine	1,214	19.4	2,368	38.3	*18.9*
Lodgepole pine	259	4.1	170	2.7	*-1.4*
Mixed conifer	3,324	53.2	698	11.3	*-41.9*
Subalpine fir	340	5.4	136	2.2	*-3.2*
Nonforested Nonwater	56	0.9	34	0.5	*-0.3*
Nonstocked	66	1.1	0	0.0	*-1.1*
Hardwoods	0	0.0	0	0.0	*0.0*
Totals[1]	6,248	100.0	6,185	100.0	

[1]The difference in totals reflects mapping precision differences between ArcMap layers

the shade-tolerant species like grand fir and western red cedar.

Data for Swan River State Forest indicates that the extent of the western white pine covertype is considerably lower than what occurred historically. White pine blister rust has drastically affected western white pine, reducing its representation across its range to less than 10 percent of historical numbers *(Fins et al. 2001).* The number of healthy western white pine that occupy the canopy as overstory dominants has been on the decline across its range for several decades despite multiorganization cooperative efforts to restore it on the landscape. So, while cooperative efforts have produced rust-resistant seed suitable for deployment throughout its range, planting has been unable to keep pace with losses due to the blister rust.

ENVIRONMENTAL EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Covertypes***

  In the short term, the amount of western larch/Douglas-fir and western white pine covertypes would remain lower than DNRC's desired future conditions suggests (*FIGURE V-2 – CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOREST* and *FIGURE V-3 – DESIRED FUTURE CONDTION BY COVERTYPE ON SWAN RIVER STATE FOREST*). Shade-tolerant species would continue to regenerate under closed-canopied forests, increasing the ladder fuels available to carry fire to the overstory and competing with the overstory for water and nutrients. The long-term effects on covertype would continue, with a gradual loss of the seral-dominated covertypes, such as western larch/Douglas-fir and western white pine, and an increase in the mixed-conifer covertype, which is dominated by shade-tolerant species.

  Forest succession, driven by the impacts of forest insects and diseases when fires are being suppressed, would reduce the variability of covertypes. As the forest ages and composition become more homogenous, biodiversity would be reduced.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Covertypes***

  All of the action alternatives apply a variety of silvicultural treatments to stands across the project area. The types of treatments include seedtree, seedtree with reserves, shelterwood, shelterwood with reserves, and variable thinning.

Seedtree and seedtree-with-reserves harvests would be applied under all of the action alternatives. This prescription emulates a stand-replacement fire because the largest share of trees would be harvested. Some fire effects would be applied when slash is piled and burned or broadcast burned. Most regeneration would be western larch, Douglas-fir, ponderosa pine, and western white pine which is similar to what would be expected following a fire. Within the western larch/Douglas-fir and western white pine covertypes, the majority of seedtrees retained would be the larger-diameter, fire-tolerant western larch, Douglas-fir, and, where available, ponderosa pine and western white pine. Within the subalpine fir and mixed-conifer covertypes, fire-tolerant seedtrees and a smaller component of western red cedar, western hemlock, grand fir, and subalpine fir, would be retained where appropriate.

Shelterwood harvesting would occur under all of the action alternatives. This prescription would emulate a mixed-severity or moderate-intensity fire. Harvesting would concentrate on shade-tolerant species, individual trees affected by insects or diseases, and those species less desirable for the desired future conditions. Regeneration would include western larch, Douglas-fir, ponderosa pine, and western white pine within the western larch/Douglas-fir and western white pine covertypes. Regeneration would include fire-tolerant seedtrees and a smaller component of western red cedar, western hemlock, Engelmann spruce, grand fir, and subalpine fir within the subalpine fir and mix-conifer covertypes.

Variable thinning treatments would be applied under all action alternatives. This prescription emulates the effects of low-intensity fires with flare-ups that are common in the mixed-severity fire regime. Harvesting would retain at least 40-percent crown cover. The species retained would primarily consist of shade-intolerant species in variable spacing that move the forest towards desired future conditions for the area while promoting horizontal and vertical diversity, or a multistoried structure, within the stand. Individual trees remaining in the stand would have more light and nutrients for continued growth and vigor.

Gravel pit development would be applied under all action alternatives. This activity would remove acreage out of a forested status and into a nonforested status. No tree species other than incidental seedlings would occur within the pit area.

Over time, untreated stands would advance in age class and gradually shift towards covertypes with shade-tolerant species. Treated stands would also advance in age class and, in the long term, could shift toward covertypes with increasingly more shade-tolerant species.

- ***Direct and Indirect Effects of Action Alternative B to Covertypes***

This alternative proposes a regeneration harvest using seedtree, seedtree-with-reserves, and shelterwood-with-reserves treatments on approximately 1,234 acres, and variable thinning on approximately 285 acres. This alternative proposes incrementally developing a gravel pit on approximately 22 acres.

Approximately 59 acres of the mixed-conifer covertype would be converted to a western larch/Douglas-fir covertype, and approximately 282 acres of the mixed-conifer covertype would be converted to a western white pine covertype by harvesting shade-tolerant species (grand fir, Engelmann spruce, western red cedar, etc) and planting various combinations of western larch, ponderosa pine, and blister rust-resistant western white pine. Approximately 36 acres of the subalpine fir covertype would be converted to a Douglas-fir covertype. Approximately 194 acres of the mixed-conifer covertype, 600 acres of the western white pine covertype, 171 acres of the western larch/ Douglas-fir, and 177 acres of the subalpine fir covertype would be harvested; no change in covertype would be expected. Approximately 12 acres of the ponderosa pine covertype and 10 acres of the mixed-conifer covertype would be converted to a nonforested covertype by developing a gravel pit.

The proportion of the western larch/ Douglas-fir covertype in the project area would increase from the current level of 15.4 percent to 16.4 percent, and the proportion of the western white pine covertype would increase from the current level of 19.6 percent to 24.2 percent due to a combination of harvest prescriptions and planting. The proportion of the mixed-conifer covertype in the project area would decrease from the current level of 53.8 percent to 48.1 percent (see *TABLE V-3 – COVERTYPE CHANGE BY ACTION ALTERNATIVE FOR SWAN RIVER STATE FOREST AND THE PROJECT AREA*).

TABLE V-3 – COVERTYPE CHANGE BY ACTION ALTERNATIVE FOR SWAN RIVER STATE FOREST AND THE PROJECT AREA

COVERTYPE	CHANGE IN ACREAGE	CHANGE IN PERCENT	
		PROJECT AREA	SWAN RIVER STATE FOREST
ACTION ALTERNATIVE B			
Ponderosa pine	-12	-0.19	-0.03
Western larch/ Douglas-fir	59	0.95	0.15
Western white pine	282	4.56	0.72
Mixed Conifer	-351	-5.68	-0.90
Subalpine fir	-36	-0.58	-0.09
Douglas-fir	36	0.58	0.09
Nonforest/ Nonwater	22	0.36	0.06
ACTION ALTERNATIVE C			
Ponderosa pine	-12	-0.19	-0.03
Western larch/ Douglas-fir	81	1.31	0.21
Western white pine	295	4.77	0.76
Mixed Conifer	-386	-6.24	-0.99
Subalpine fir	0	0.00	0.00
Douglas-fir	0	0.00	0.00
Nonforest/ Nonwater	22	0.36	0.06
ACTION ALTERNATIVE D			
Ponderosa pine	-12	-0.19	-0.03
Western larch/ Douglas-fir	55	0.89	0.14
Western white pine	155	2.51	0.40
Mixed Conifer	-220	-3.56	-0.57
Subalpine fir	-36	-0.58	-0.09
Douglas-fir	36	0.58	0.09
Nonforest/ Nonwater	22	0.36	0.06

- ***Direct and Indirect Effects of Action Alternative C to Covertypes***

  This alternative proposes regeneration harvests using seedtree, seedtree-with-reserves, shelterwood, and shelterwood-with-reserves treatments on approximately 1,403 acres and variable thinning on approximately 160 acres. This alternative also proposes incrementally developing a gravel pit on approximately 22 acres.

  Approximately 81 acres of the mixed-conifer covertype would be converted to a western larch/Douglas-fir covertype, and approximately 295 acres of the mixed-conifer covertype would be converted to a western white pine covertype by harvesting shade-tolerant species (grand fir, Engelmann spruce, western red cedar, etc.) and planting various combinations of western larch, ponderosa pine, and blister rust-resistant western white pine. Approximately 240 acres of the mixed-conifer covertype, 790 acres of the western white pine covertype, and 157 acres of the western larch/Douglas-fir covertype would be harvested; no change in covertype would be expected. Approximately 12 acres of the ponderosa pine covertype and 10 acres of the mixed-conifer covertype would be converted to a nonforested covertype by developing a gravel pit.

The proportion of the western larch/ Douglas-fir covertype in the project area would increase from the current level of 15.4 percent to 16.7 percent, and the proportion of the western white pine covertype would increase from the current level of 19.6 percent to 24.4 percent due to a combination of harvesting prescriptions and planting. The proportion of the mixed-conifer covertype in the project area would decrease from the current level of 53.8 percent to 47.5 percent (see *TABLE V-3 – COVERTYPE CHANGE BY ACTION ALTERNATIVE FOR SWAN RIVER STATE FOREST AND THE PROJECT AREA*).

- ***Direct and Indirect Effects of Action Alternative D to Covertypes***

This alternative proposes regeneration harvests using seedtree, seedtree-with-reserves, shelterwood, and shelterwood-with-reserves treatments on approximately 1,051 acres and variable thinning on approximately 135 acres. This alternative also proposes incrementally developing a gravel pit on approximately 22 acres.

Approximately 55 acres of the mixed-conifer covertype would be converted to a western larch/Douglas-fir covertype, and approximately 155 acres of the mixed-conifer covertype would be converted to a western white pine covertype by harvesting shade-tolerate species (grand fir, Engelmann spruce, western red cedar, etc.) and planting various combinations of western larch, ponderosa pine, and blister rust-resistant western white pine. Approximately 36 acres of the subalpine fir covertype would be converted to a Douglas-fir covertype. Approximately 99 acres of the mixed-conifer covertype, 505 acres of the western white pine covertype, 97 acres of the western larch/Douglas-fir covertype, 62 acres of the lodgepole pine covertype, and 177 acres of the subalpine fir covertype would be harvested; no change in covertype would be expected. Approximately 12 acres of the ponderosa pine covertype and 10 acres of the mixed-conifer covertype would be converted to a nonforested covertype by developing a gravel pit.

The proportion of the western larch/ Douglas-fir covertype in the project area would increase from the current level of 15.4 percent to 16.3 percent and the proportion of the western white pine covertype would increase from the current level of 19.6 percent to 22.1 percent due to a combination of harvest prescriptions and planting. The proportion of the mixed-conifer covertype in the project area would decrease from the current level of 53.8 percent to 50.2 percent (see *TABLE V-3 – COVERTYPE CHANGE BY ACTION ALTERNATIVE FOR SWAN RIVER STATE FOREST AND THE PROJECT AREA*).

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Covertypes***

The cumulative effects of recent forest management on Swan River State Forest resulted in a trend of increasing seral covertypes across areas where management occurred. For example, the South Woodward and Goat Squeezer timber sale projects increased the western larch/Douglas-fir covertype on Swan River State Forest through timber harvesting, with planting in selected units.

In addition to the changes in proportions of covertype proposed in the various action alternatives, other timber sale projects have been initiated, but not completed; therefore, their effects are not represented in the SLI layers and analysis layers (*swn sliswnc20050513, swn_sli20060928, patch_041008).* Scheduled updates of the SLI would capture increased western larch/Douglas-fir and western white pine covertypes on Swan River State Forest.

The Winter Blowdown and Lucky Logger timber permits removed dead, dying, windthrown, or infected Douglas-fir, grand fir, western white pine, and western larch. The Low Wood Salvage 2 Permit, once completed, will have similar results. The covertypes of these stands would not be affected. South Woodward 28 Salvage Permit and Main Wood Timber Permit are currently in the process of being developed; age class or covertype of these stands would not be affected.

The Three Creeks Timber Sales (1, 2, 3, and Small Lost) are currently in the process of being developed and sold. Through seedtree, seedtree-with-reserves, shelterwood, and commercial thinning treatments, 1,884 acres will be harvested. The post-treatment covertypes of these stands have been incorporated into the current age class and covertype amounts. These treatments will continue the trend of increasing seral covertypes and decreasing late-successional covertypes across areas where management occurred.

Based upon aerial photograph interpretation on a landscape basis, the cumulative effects to covertype distributions due to previous activities on USFS as well as privately held ground, including Plum Creek property and small, private landholdings adjacent to Swan River State Forest and the project area, have been difficult to interpret due to the scale. The trend typically is late seral species within old stands and a mosaic of early to late seral species in younger or treated stands, the results being dependent on the residual timber, harvest prescription, and postharvest treatments. Development plans on small, private landholdings could result in a decrease in covertypes as land is converted to nonforested.

- ***Cumulative Effects of Action Alternatives B, C, and D to Covertypes***

The cumulative effects of the action alternatives would be similar to those seen in the No-Action Alternative A; however, in general, the result would be a greater increase in seral covertypes across areas where management occurs.

AGE CLASS

Issue: The proposed activities may affect forest age classes through tree removal.

EXISTING ENVIRONMENT

The distribution of age classes delineates another characteristic important for determining trends on a landscape level. Age-class distributions are tied to covertype representation and disturbance regimes, both of which vary over the landscape in relation to prevailing climatic conditions of temperature and moisture.

Historical stand age-class distributions for Montana were developed by *Losensky (1997)*. Although the data was collected at a specific point in time, this data represents the best baseline available for determining how current age-class distribution deviates from historical conditions.

Comparison of the climatic section average with the inventory data from the 1930s for Swan River State Forest shows that the Forest was dominated by old stands to a much greater extent than was the climatic section, 74 percent old stands versus 29 percent (*FIGURE V-4 - HISTORIC AGE-CLASS DISTRIBUTION FOR SWAN RIVER STATE FOREST, FIGURE V-5 - HISTORIC AGE-CLASS DISTRIBUTION FOR CLIMATIC SECTION M333C, TABLE V-4 – HISTORIC AGE-CLASS STRUCTURE FOR EACH COVERTYPE IN CLIMATIC SECTION M333C (UPPER FLATHEAD VALLEY),* and *TABLE V-5 - 1930s INVENTORY DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE FOR SWAN RIVER STATE FOREST AND TOTAL ACRES BY COVERTYPE).* That trend was also demonstrated with most of the various covertypes. The 1930s data indicates that Swan River State Forest avoided major disturbances for a considerable time period.

Comparison of the current distribution of age classes by covertype within the project area, as well as across the entire Swan River State Forest, to the historical data for *Section M333C* demonstrates reduced acreage in the seedling-sapling age class (the 0-to-39-year age class versus the 1-to-40-year age class) and an overabundance in the old-stands age class in most types (*TABLE V-4 – HISTORIC AGE-CLASS STRUCTURE FOR EACH COVERTYPE IN CLIMATIC SECTION M333C (UPPER FLATHEAD VALLEY),*

FIGURE V-4 – HISTORIC AGE-CLASS DISTRIBUTION FOR SWAN RIVER STATE FOREST

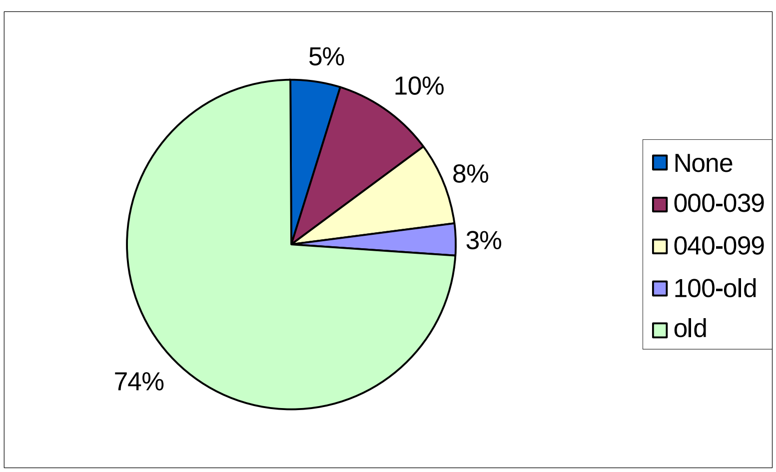


FIGURE V-5 – HISTORIC AGE-CLASS DISTRIBUTION FOR CLIMATIC SECTION M333C

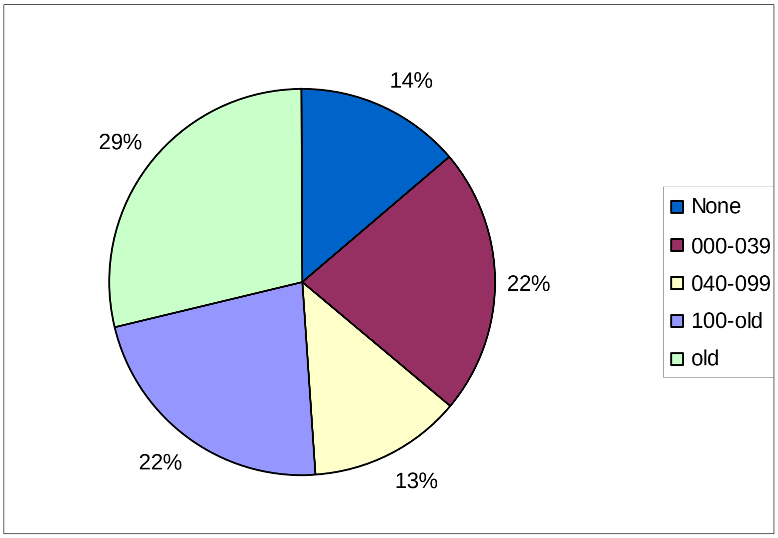


TABLE V-4 – HISTORIC AGE-CLASS STRUCTURE FOR EACH COVERTYPE IN CLIMATIC SECTION M333C (UPPER FLATHEAD VALLEY)

COVERTYPE[1]	NONSTOCKED	1 TO 40 YEARS	41 TO 100 YEARS	101 YEARS TO OLD STANDS	OLD STANDS[2]
	PERCENT				
Ponderosa pine	2	11	6	7	74
Douglas-fir	2	24	39	29	6
Western larch/ Douglas-fir	10	13	10	20	47
Western white pine	0	1	28	54	17
Lodgepole pine	21	38	29	7	5
Mixed conifer[3]	2	4	9	42	43
Average [4]	14	22	13	22	29

[1] *The subalpine type was not assigned an age in the 1930s inventory.*

[2] *Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas-fir; 180 years for western white pine and mixed conifer; and 140 years for lodgepole pine.*

[3] *Mixed conifer under SLI, spruce-fir under Losensky.*

[4] *Average represents the average age-class structure across all covertypes.*

TABLE V-5 – 1930s INVENTORY DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE FOR SWAN RIVER STATE FOREST AND TOTAL ACRES BY COVERTYPE

COVERTYPE	NO AGE[1]	0 TO 39 YEARS	40 TO 99 YEARS	100 YEARS TO OLD STANDS	OLD STANDS[2]	TOTAL ACRES
	PERCENT					
Ponderosa pine		0	0	0	100	1,019
Douglas-fir	100	0	0	0	0	219
Western larch/ Douglas-fir		12	7	0	81	26,253
Western white pine		0	0	0	100	3,159
Lodgepole pine		36	64	0	0	1,801
Mixed conifer[3]	5	0	18	2	74	1,345
Subalpine fir	31	0	1	21	47	4,588
Average[4]	5	10	8	3	74	38,668

[1]*The NO AGE category represents land that was not typed as to age in the 1930s inventory.*
[2]*Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas-fir; 180 years for western white pine, subalpine fir, and mixed conifer; and 140 years for lodgepole pine.*
[3] *Mixed conifer under SLI, spruce-fir under Losensky.*
[4] *Average represents the average age-class structure across all covertypes.*

TABLE V-6 – CURRENT SWAN RIVER STATE FOREST DATA (INCLUDING THREE CREEKS ADJUSTMENTS) FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE AND TOTAL ARES BY COVERTYPE and *TABLE V-7 - CURRENT PROJECT AREA DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE AND TOTAL ACRES BY COVERTYPE).* The relatively old age of stands in Swan River State Forest predisposes them to attacks by insects and diseases, as well as an increased risk of stand- replacement fires.

ENVIRONMENTAL EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Age Classes***

  No immediate change in the proportion of existing age classes (*FIGURE V-6 – CURRENT AGE-CLASS DISTRIBUTION FOR SWAN RIVER STATE FOREST* and *FIGURE V-7 – CURRENT AGE-CLASS DISTRIBUTION FOR THE PROJECT AREA*) is expected unless a large disturbance, such as a wildfire, occurs.

  Forest succession, driven by the impacts of forest insects and diseases when fires are being suppressed, would reduce the variability of age classes. As the forest ages and its composition become more homogenous, biodiversity would be reduced.

- ***Direct and Indirect Effects of Action Alternative B to Age Classes***

  The proposed seedtree, seedtree-with-reserves, and shelterwood treatments

TABLE V-6 – CURRENT SWAN RIVER STATE FOREST DATA (INCLUDING THREE CREEKS ADJUSTMENTS) FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE AND TOTAL ACRES BY COVERTYPE

COVERTYPE	NO AGE[1]	0 TO 39 YEARS	40 TO 99 YEARS	100 YEARS TO OLD STANDS	OLD STANDS[2]	TOTAL ACRES
	PERCENT					
Ponderosa pine		12	39	6	43	2,406
Douglas-fir		0	40	21	39	537
Western larch/ Douglas-fir	3	17	29	21	30	9,737
Western white pine		20	1	9	70	4,236
Lodgepole pine		6	67	24	3	2,054
Mixed conifer		8	14	20	58	15,800
Subalpine fir		10	12	24	54	3,256
Nonforested/Nonwater	100					908
Average [3]	3	12	21	18	46	38,934

[1]*The NO AGE category represents land that is nonforest or does not have an age class listed.*

[2]*Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas-fir; 180 years for western white pine, subalpine fir, and mixed conifer; and 140 years for lodgepole pine. Other covertypes not included in the table: hardwoods (40 acres), and nonstocked (706 acres).*

[3]*Average represents the average age-class structure across all covertypes.*

TABLE V-7 – CURRENT PROJECT AREA DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE AND TOTAL ACRES BY COVERTYPE

COVERTYPE	NO AGE[1]	0 TO 39 YEARS	40 TO 99 YEARS	100 YEARS TO OLD STANDS	OLD STANDS[2]	TOTAL
	PERCENT					ACRES
Ponderosa pine		100	0	0	0	21
Douglas-fir		100	0	0	0	14
Western larch/ Douglas-fir		32	12	29	27	954
Western white pine		24	0	10	66	1,214
Lodgepole pine		7	50	43	0	259
Mixed conifer		18	10	10	62	3,324
Subalpine fir		0	5	75	20	340
Nonforested/Nonwater	100					56
Average[3]	1	20	10	18	51	6,182

[1]*The NO AGE category represents land that is nonforest or does not have an age class listed.*

[2]*Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas- fir; 180 years for western white pine, subalpine fir, and mixed conifer; and 140 years for lodgepole pine.*

[3] *Average represents the average age-class structure across all covertypes.*

FIGURE V-6 – CURRENT AGE-CLASS DISTRIBUTION FOR SWAN RIVER STATE FOREST

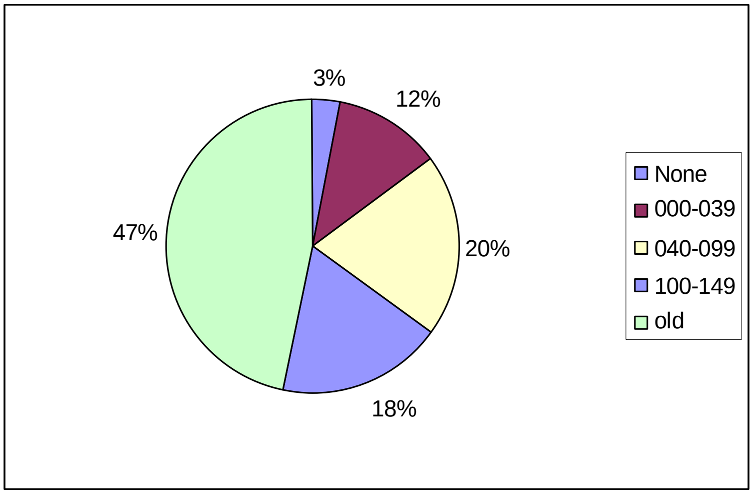
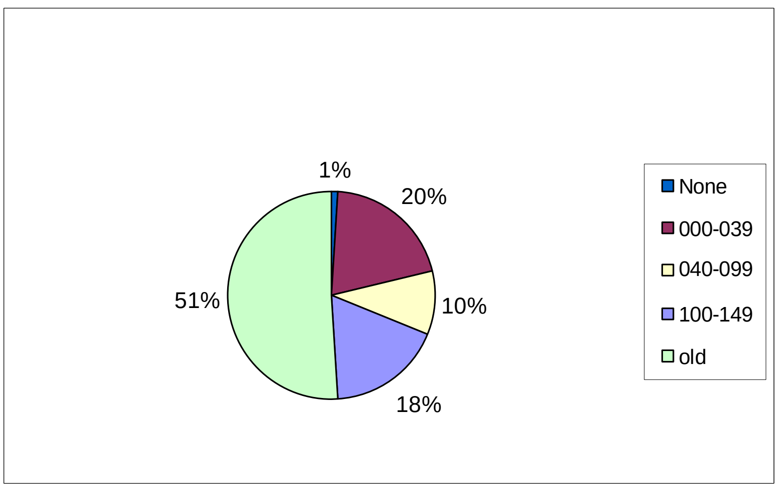


FIGURE V-7 – CURRENT AGE-CLASS DISTRIBUTION FOR THE PROJECT AREA



with this alternative would regenerate approximately 1,234 acres. Of this, 1,014 acres would be converted from the old-stand age class to the zero-year age class, 149 acres would be converted from the 100-to-149-year age class to the zero-year age class, and 71 acres would retain the 100-to-149-year age class. The proposed gravel pit would convert 22 acres from the 0-to-39-year age class to the nonforested age class.

The 285 acres proposed for variable thinning would retain pole- to sawtimber-sized trees. About 183 acres would be converted from the old-stand age class to the 100-to-149-year age class, and 102 acres would retain the 100-to-149-year age class.

Regeneration treatments and the subsequent planting or natural regeneration would increase the proportion of the 0-to-39-year age class on Swan River State Forest by 2.9 percent and in the project area by 18.5 percent, or 1,141 acres. The old-stand age class on Swan River State Forest would be reduced by 3.1 percent and in the project area by 19.3 percent, or 1,197 acres *(FIGURE V-8 – AGE-CLASS DISTRIBUTION IN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE B, TABLE V-8 - PROJECT AREA POSTHARVEST AGE-CLASS DISTRIBUTION BY COVERTYPE FOLLOWING ACTION ALTERNATIVE IMPLEMENTATION*, and *TABLE V-9 - SWAN RIVER STATE FOREST POSTHARVEST AGE-CLASS DISTRIBUTION BY COVERTYPE FOLLOWING ACTION ALTERNATIVE IMPLEMENTATION).*

- ***Direct and Indirect Effects of Action Alternative C to Age Classes***

The proposed seedtree, seedtree-with-reserves, shelterwood, and shelterwood-with-reserves treatments in this alternative would regenerate approximately 1,403 acres. Of this, 1,204 acres would be converted from the old-stand age class to the zero-year age class, 46 acres would be converted from the 100-to-149-year age class to the zero-year age class, 124 acres would retain the 100-to-149-year age class, and 33 acres would be converted from the old-stand age class to the 100-to-149-year age class. The proposed gravel pit would convert 22 acres from the 0-to-39-year age class to the nonforested age class.

The 160 acres proposed for variable thinning would retain pole- to sawtimber-sized trees. Approximately 105 acres would be converted from the old-stand age class to the 100–to-149-year age class, 33 acres would retain the 100-to-149-year age class, and 22 acres would retain the 40-to-99-year age class.

FIGURE V-8 – AGE-CLASS DISTRIBUTION IN THE PROJECT AREA FOLLOWING THE APPLICATION OF ACTION ALTERNATIVE B

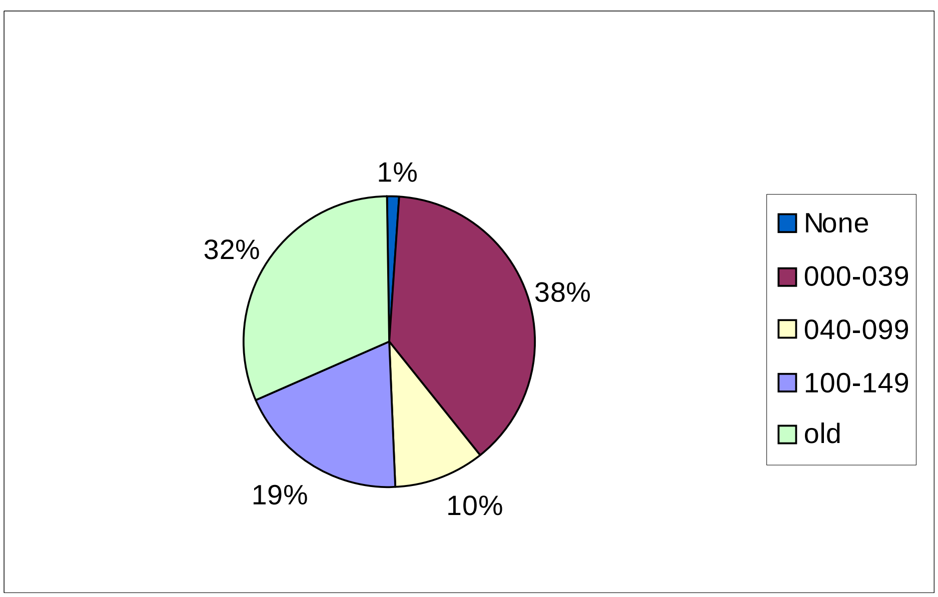


TABLE V-8 - PROJECT AREA POSTHARVEST AGE-CLASS DISTRIBUTION BY COVERTYPE FOLLOWING ACTION ALTERNATIVE IMPLEMENTATION

COVERTYPE			NO AGE[1]	0 TO 39 YEARS	40 TO 99 YEARS	100 YEARS TO OLD STANDS	OLD STANDS[2]	TOTAL
Ponderosa pine	Current			21	0	0	0	21
	Action Alternative	B		9	0	0	0	9
		C		9	0	0	0	9
		D		9	0	0	0	9
Douglas-fir	Current			0	14	0	0	14
	Action Alternative	B		36	14	0	0	50
		C		0	14	0	0	14
		D		36	14	0	0	50
Western larch/ Douglas-fir	Current			306	116	277	255	954
	Action Alternative	B		441	116	372	84	1,013
		C		425	116	277	217	1,035
		D		361	116	277	255	1,009
Western white pine	Current			291	0	117	806	1,214
	Action Alternative	B		1,149	0	108	239	1,496
		C		1,292	0	108	109	1,509
		D		891	0	84	394	1,369
Lodgepole pine	Current			18	129	112	0	259
	Action Alternative	B		18	129	112	0	259
		C		18	129	112	0	259
		D		80	129	50	0	259
Mixed conifer	Current			600	336	347	2,041	3,324
	Action Alternative	B		649	336	406	1,582	2,973
		C		720	336	444	1,438	2,938
		D		689	336	347	1,732	3,104
Subalpine fir	Current			0	17	256	67	340
	Action Alternative	B		75	17	145	67	304
		C		0	17	256	67	340
		D		75	17	145	67	304
Nonforest Nonwater	Current		56					56
	Action Alternative	B	78					78
		C	78					78
		D	78					78

[1]*The NO AGE category represents land that is nonforest or does not have an age class listed in the SLI.*

[2]*Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas-fir; 180 years for western white pine, subalpine fir, and mixed conifer; and 140 years for lodgepole pine.*

Other covertypes not included in the table: hardwoods (40 acres) and nonstocked (706 acres).

TABLE V-9 - SWAN RIVER STATE FOREST POSTHARVEST AGE CLASS DISTRIBUTION BY COVERTYPE FOLLOWING ACTION ALTERNATIVE IMPLEMENTATION

COVERTYPE			NO AGE[1]	0 TO 39 YEARS	40 TO 99 YEARS	100 YEARS TO OLD STANDS	OLD STANDS[2]	TOTAL
			ACRES					
Ponderosa pine	Current			295	942	143	1,026	2,406
	Action Alternative	B		283	942	143	1,026	2,394
		C		283	942	143	1,026	2,394
		D		283	942	143	1,026	2,394
Douglas-fir	Current			0	217	112	208	537
	Action Alternative	B		36	217	112	208	573
		C		0	217	112	208	537
		D		36	217	112	208	573
Western larch/ Douglas-fir	Current		267	1,611	2,867	1,996	2,996	9,737
	Action Alternative		267	1,746	2,867	2,091	2,825	9,796
			267	1,730	2,867	1,996	2,958	9,818
			267	1,666	2,867	1,996	2,996	9,792
Western white pine	Current			844	56	396	2,940	4,236
	Action Alternative	B		1,702	56	387	2,373	4,518
		C		1,845	56	387	2,243	4,531
		D		1,444	56	363	2,528	4,391
Lodgepole pine	Current			117	1377	498	62	2,054
	Action Alternative	B		117	1377	498	62	2,054
		C		117	1377	198	62	1,754
		D		179	1377	436	62	2,054
Mixed conifer	Current		30	1,325	2,160	3,053	9,202	15,770
	Action Alternative	B	30	1,374	2,160	3,142	8,743	15,449
		C	30	1,445	2,160	3,180	8,599	15,414
		D	30	1,414	2,160	3,081	8,895	15,580
Subalpine fir	Current			313	391	789	1,763	3,256
	Action Alternative	B		388	391	678	1,763	3,220
		C		313	391	789	1,763	3,256
		D		388	391	678	1,763	3,220
Nonforest Nonwater	Current		908					908
	Action Alternative	B	930					930
		C	930					930
		D	930					930

[1] The NOAGE category represents land that is nonforest or does not have an age class listed within the SLI.

[2] Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas-fir; 180 years for western white pine, subalpine fir, and mixed conifer; and 140 years for lodgepole pine.

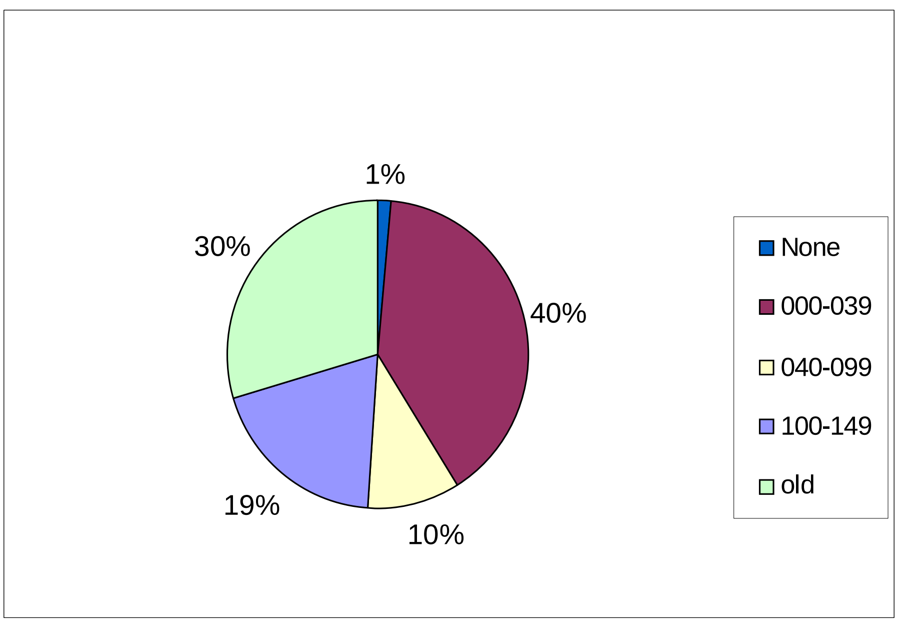
Other covertypes not included in the table: hardwoods (40 acres), and nonstocked (706 acres).

Regeneration treatments and the subsequent planting or natural regeneration would increase the proportion of the 0–to-39-year age class on Swan River State Forest by 3.1 percent and in the project area by 18.5 percent, or 1,228 acres. The proportion of the old-stand age class on Swan River State Forest would be reduced by 3.4 percent and in the project area by 21.6 percent, or 1,238 acres *(FIGURE V-9 – AGE-CLASS DISTRIBUTION IN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE C, TABLE V-8 - PROJECT AREA POSTHARVEST AGE-CLASS DISTRIBUTION BY COVERTYPE FOLLOWING ACTION ALTERNATIVE IMPLEMENTATION,* and *TABLE V-9 - SWAN RIVER STATE FOREST POSTHARVEST AGE-CLASS DISTRIBUTION BY COVERTYPE FOLLOWING ACTION ALTERNATIVE IMPLEMENTATION).*

- ***Direct and Indirect Effects of Action Alternative D to Age Classes***

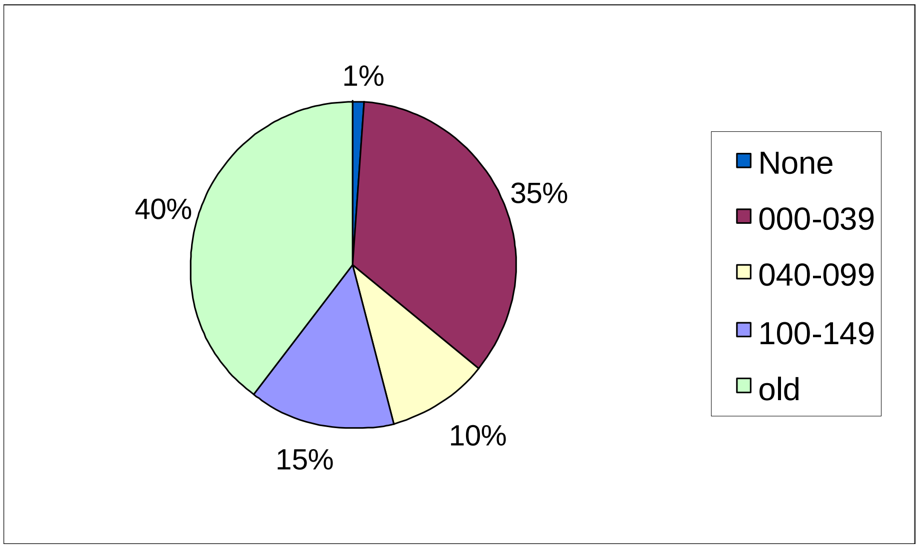
The proposed seedtree, seedtree-with-reserves, shelterwood, and shelterwood-with-reserves treatments in this alternative would regenerate approximately 1,051 acres. Of this, 661 acres would be converted from the old-stand age class to the zero-year age class, 237 acres would be converted from the 100-to-149-year age class to the zero-year age class, 29 acres would be converted from the old-stand age class to the 100-to-149-year age class, and 124 acres would retain the 100-to-149-year age class. The 135 acres proposed for variable thinning would retain pole- to sawtimber-sized trees. Approximately 135 acres would retain the 100-to-149-year age class. The proposed gravel pit would convert 22 acres from the 0-to-39-year age class to the nonforested age class.

FIGURE V-9 – AGE-CLASS DISTRIBUTION IN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE C



Regeneration treatments and the subsequent planting or natural regeneration would increase the proportion of the 0-to -39-year age class on Swan River State Forest by 2.3 percent and in the project area by 14.6 percent, or 905 acres. The proportion of the old-stand age class on Swan River State Forest would be reduced by 1.9 percent and in the project area by 11.6 percent, or 719 acres *(FIGURE V-10 – AGE-CLASS DISTRIBUTION IN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE D, TABLE V-8 - PROJECT AREA POSTHARVEST AGE-CLASS DISTRIBUTION BY COVERTYPE FOLLOWING ACTION ALTERNATIVE IMPLEMENTATION*, and *TABLE V-9 - SWAN RIVER STATE FOREST POSTHARVEST AGE-CLASS DISTRIBUTION BY COVERTYPE FOLLOWING ACTION ALTERNATIVE IMPLEMENTATION).*

FIGURE V-10 – AGE-CLASS DISTRIBUTION IN THE PROJECT AREA FOLLOWING THE APPLICATION OF ACTION ALTERNATIVE D



Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Age Classes***

The cumulative effects of recent forest management on Swan River State Forest resulted in a trend of increasing acres in the 0-to-39-year age class. For example, the South Woodward and Goat Squeezer timber sale projects increased the 0-to-39-year age class on Swan River State Forest through timber harvesting and planting in selected units.

In addition to the changes in proportions of age classes proposed in the various action alternatives, other timber sale projects have been initiated, but not completed; therefore, their effects are not represented in the SLI and analysis layers (*swn sliswnc20050513, swn_sli2006092, patch_041008).* Scheduled updates of the SLI would capture increased acres in the 0-to-39-year age class on Swan River State Forest.

The Winter Blowdown and Lucky Logger timber permits removes dead, dying, windthrown, or infected Douglas-fir, grand fir, western white pine, and western larch. Age class will not be affected. Once completed, the Low Wood timber permits would have similar results. The South Woodward 28 Salvage Permit and Main Wood Timber Permit are currently in the process of being developed; the age class of these stands would not be affected.

Three Creeks Timber Sales (1, 2, 3, and Small Lost) is currently in the process of being developed and sold. Through seedtree, seedtree-with-reserves, shelterwood, and commercial thinning treatments, 1,884 acres will be harvested. The posttreatment age classes of these stands have been incorporated into the current age-class amounts. These treatments will continue the trend of increasing the zero-age class and decreasing the old-age class across areas where management occurs.

Based upon aerial photograph interpretation on a landscape basis, the cumulative effects to age-class distributions due to previous activities on USFS as well as privately held ground, including Plum Creek property and small, private landholdings adjacent to Swan River State Forest and the project area, has been a reduction in the acres of the old-age class and an increase in the acres of the younger age classes. Based upon aerial photograph interpretation, approximately 50 percent of the acreage appears to consist of stands in the 0-to-39-year age class. Age class approximations were not possible on the remainder of the ground. Development plans on small, private landowners could result in a decrease in total age-class distribution as ground is converted to nonforested.

The cumulative effects to age-class distributions due to previous activities on Swan River State Forest are represented in descriptions of the current condition. Generally speaking, those effects have been to reduce the acres in the older age classes while increasing the acres in the younger age classes versus the snapshot of the forest represented in the 1930s inventory. Regarding long-term sustainable conditions, DNRC's process indicates the movement of acres from older to younger age classes is in keeping with a movement toward average historical conditions.

- ***Cumulative Effects of Action Alternatives B, C, and D to Age Classes***

  The cumulative effects of the action alternatives would be similar to those seen in the No-Action Alternative; however, the result would be a greater increase in the 0-to-39-year-old age class across areas where even-aged management would occur.

OLD GROWTH

Issue: The proposed activities may affect old-growth amounts and quality through tree removal.

EXISTING ENVIRONMENT

DNRC defines old growth as stands that meet minimum criteria for number, size, and age of trees per acre for a given combination of covertype and habitat-type group. The definitions are adopted from those presented by *Green et al., (1992)*. DNRC's definition has evolved over the years; previous analysis may appear to contradict the analysis presented in this DEIS because of that evolution.

Historic Estimates of Old Growth

Many previous efforts have been made to estimate the historical amounts of old growth in Swan Valley. The following approaches have been used:

- DNRC estimated the quantity of old growth that may have existed historically (*Montana DNRC 2000*). Results suggested that, given the definition used in the analysis, approximately 22 percent of Swan River State Forest represents the expected amount of naturally occurring old growth. That analysis used a more restrictive definition for old growth than DNRC currently uses.
- *FNF Plan Amendment 21 (1998)* estimated that 29 percent of low-elevation forests on FNF was old growth, 8 percent of mid-elevation forest was old growth, and none of the high-elevation forest was old growth, as derived from historic surveys (*Ayers 1898, 1899*). Using various sources of information, the *FNF Amendment 21* also estimated that old growth in FNF had an historical range of variability from 15 to 60 percent. Using a computer modeling process, FNF estimated that approximately 36 percent of Swan Valley existed as late-seral forest; however, not all late-seral stands would qualify as old growth.
- *Lesica (1996)*, in an effort to use fire history to estimate the proportions of old-growth forests in Swan Valley, estimated that approximately 52 percent of the area was occupied by stands that were 180 years or older. *Lesica* used stand age as a surrogate for old growth in his mathematically derived estimations.
- Using covertype conditions and historical data from the 1930s (*Losensky 1997*), 29 percent of the forested acres in the Upper Flathead Climatic Section were estimated to have historically been occupied by stands 150 years and older and contained a minimum of 4 Mbf/acre (*SOUTH FORK LOST CREEK FEIS, 1998*).
- *Hart (1989)* indicated that approximately 48 percent of the area represented in the 1930s stand data for the Seeley and Swan valleys had forests with a significant component of trees older than 200 years.

Therefore, using a wide variety of old-growth definitions, the estimates of the historic amount of old growth on Swan River State Forest suggest a range from 15 to 50 percent. The estimates above are primarily age-based estimates that do not consider the other attributes, such as number of snags or coarse woody debris, often deemed necessary to call a stand 'old growth'. The lack of additional old-growth attributes in many of the old-growth definitions results in overestimated amounts of old growth compared to other old-growth definitions that include additional attribute thresholds. For example, only DNRC's estimate has any criteria related to the size and number of large trees per acre, leading one to the conclusion that old growth would necessarily be lower than the other estimates provided because not all old stands, late-seral stands, or modeled stands would have sufficient numbers of large live trees to meet DNRC's old-growth definition.

Estimates presented defined old growth in a variety of ways and none of them represent estimates based on the *Green et al. (1992)* definition that DNRC currently uses; most provide estimates that are higher than they would be if they included additional attribute criteria.

Based on available estimates, the amount of old growth on Swan River State Forest is currently within the historically occurring range.

Analysis Methods

DNRC uses criteria set forth in *Green et al. (1992)* to define old growth. The definition sets minimum thresholds for the number and size of large trees based on habitat type and covertype. The old-growth analysis relies on DNRC's SLI and ocular observations in the field. The SLI was queried to select stands meeting the age, diameter at breast height (dbh), and large-tree criteria for old growth based on habitat-type groups (see *GLOSSARY* for DNRC's old-growth definition). Field surveys were employed to collect minimal plot-level data and conduct ocular observations to verify the old-growth status of selected stands and determine if additional stands meet the old-growth definition within the project area. Using the SLI, attribute levels within the old-growth stands are described and analyzed for preharvest and postharvest conditions. For instance, the SLI database contains data on snag numbers. This data was used as the database appeared more consistent than the limited plot data taken in the field.

Relationship to the Sustained Yield Calculation

DNRC's management activities are guided by the philosophy of the SFLMP, the Forest Management Administrative Rules of Montana, and other relevant rules and laws including the requirement to calculate an annual sustainable yield. As defined in *77-5-221 MCA* and pursuant to *77-5-222* and *223 MCA*, the Department is required to recalculate the annual sustained yield at least once every 10 years. The sustained-yield calculation is done to determine the amount of timber that can be sustainably harvested, on an annual basis, from forested state trust lands in accordance with all applicable state and federal laws. The most recent sustained yield calculation was approved by the Land Board on October 18, 2004.

The recent sustained yield calculation fully incorporated the philosophy of the SFLMP and all applicable laws, rules and regulations. Biodiversity, forest health, endangered species considerations, and desired future conditions are important aspects of state forest land management, including old-growth management. These factors were modeled in the recent sustained yield calculation and are reflected in the various constraints applied to the model, which included management constraints in old-growth stands, and implementation.

The biodiversity and old-growth Administrative Rules that were incorporated into the sustained-yield model were developed with public input. The managed old-growth concept means that harvest treatments in old-growth stands contributed to the calculated sustainable yield. For example, maintenance and restoration treatments were allowed to occur periodically in some old-growth stands, while the model also allowed old-growth-removal treatments to be applied to other stands. Given the concerns expressed by some of the public regarding old growth, the sustained-yield model made provisions for tracking old-growth amounts over the planning horizon in order to determine whether landscape-level biodiversity objectives in the SFLMP and ARMs were met. At the initiation of the model runs, approximately 11 percent of DNRC-managed land met the Department's old-growth definition. After incorporating the Department's old-growth management regimes and all relevant constraints into the model, approximately 8 percent of the landscape was intended to be in an old-growth condition at model year 100. The model clearly demonstrates that this is achievable at the current sustained yield of 53.2 MMbf given current management practices, rules, and laws.

This project's effects to old-growth amounts result in postharvest quantities that are well above the range expected to occur over the long term as a result of implementing the SFLMP and Forest Management Rules.

Existing Old-Growth Distribution

Swan River State Forest currently has 12,116 acres of old growth, which is equal to 31.1 percent of the total acreage. The project area contains 2,722 acres of old growth, which is equal to 44.0 percent of the project area. Old-growth acreages may change as field surveys are completed and the SLI database is updated. *TABLE V-10 - CURRENT OLD-*

TABLE V-10 – CURRENT OLD-GROWTH ACRES AND POSTHARVEST ACTION ALTERNATIVE EFFECTS BY FOREST TYPE FOR SWAN RIVER STATE FOREST

OLD-GROWTH TYPE	OLD-GROWTH ACRES	POSTHARVEST ACTION ALTERNATIVE B	C	D
Douglas-fir	8	8	8	8
Western larch/ Douglas-fir	1,860	1,784	1,822	1,860
Western white pine	2,197	1,679	1,588	1,810
Mixed conifer	6,291	5,922	5,824	6,068
Subalpine fir	1,098	1,098	1,098	1,098
Lodgepole pine	62	62	62	62
Ponderosa pine	600	600	600	600
Totals	*12,116*	*11,153*	*11,002*	*11,506*

Action Alternative B had 64 acres of mixed conifer old growth, 24 acres of western white pine old growth, and 95 acres of western larch/ Douglas-fir old growth that were treated, but retained old-growth status. Action Alternative C had 81 acres of mixed conifer old growth and 24 acres of western white pine old growth that were treated, but retained old-growth status.

GROWTH ACRES AND POSTHARVEST ACTION ALTERNATIVE EFFECTS BY FOREST COVERTYPE FOR SWAN RIVER STATE FOREST shows the amount of acres in old-growth status per covertype according to the current SLI database information. The current analysis also looks at the old-growth spatial distribution to analyze the effects of a proposed action.

TABLE V-10 - CURRENT OLD-GROWTH ACRES AND POSTHARVEST ACTION ALTERNATIVE EFFECTS BY FOREST COVERTYPE FOR SWAN RIVER STATE FOREST presents total acres of old growth by forest type. Covertypes reflect the interactions of disturbance history, species requirements for regeneration, physiography, and availability of a seed source. The old-growth definitions used by DNRC are expressed in terms of covertype, thus allowing comparisons to *Losensky's (1997)* historic information for amounts of old-age stands. Mixed conifer, western larch/Douglas-fir, and western white pine (*TABLE V-10 - CURRENT OLD-GROWTH ACRES AND POSTHARVEST ACTION ALTERNATIVE EFFECTS BY FOREST COVERTYPE FOR SWAN RIVER STATE FOREST*) are currently the 3 dominant old-growth types on Swan River State Forest.

FIGURE V-11 - CURRENT OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST is a map of old-growth stands in the project area. In addition to old-growth stands in the project area that have been identified by the SLI, approximately 1,429 acres of old growth have been field-verified through ocular observation as well as limited tree boring.

Previous Treatments in Classified Old Growth

Swan River State Forest has had an ongoing salvage and sanitation program for years. This program has resulted in the reduction of some old-growth attributes in many current old-growth stands through the effects of timber harvesting. The effects of these previous entries include lower attribute levels in the following categories: fewer acres with high numbers of large trees, lower snag numbers, and less coarse woody debris.

High Risk Old-Growth Stands

As time passes, various factors influencing stand development may cause stands currently defined as old growth to no longer meet the requirements of the *Green et al. (1992)* old-growth definitions. Such factors include insect and disease outbreaks, drought, competition, etc. These factors can, gradually or suddenly, reduce the number of large, live trees below the minimum described in *Green et al. (1992)*. A substantial number of old-growth stands are at high risk of falling out of the old-growth status in the project area.

Currently, 1,320 acres, or 48.5 percent, of the old-growth stands in the project area are classified as high risk (see *TABLE V-11 – CURRENT AND POSTHARVEST AMOUNTS OF HIGH-RISK OLD-GROWTH STANDS).* This classification is based on stand vigor, insect and disease presence, and current mortality levels as determined by field reconnaissance and SLI data. Presumably, 48.5 percent of the old-growth stands are at risk of falling out of the old-growth status due to these current conditions. As shown by *TABLE V-11- CURRENT AND POSTHARVEST AMOUNT OF HIGH-RISK OLD-GROWTH STANDS,*

TABLE V-11 – CURRENT AND POSTHARVEST AMOUNTS OF HIGH RISK OLD-GROWTH STANDS

	POSTHARVEST TREATMENT OLD-GROWTH STATUS			
	HIGH RISK OLD GROWTH	OTHER OLD GROWTH	NOT OLD GROWTH	TOTALS
Current and No-Action Alternative A	1,320	1,402	0	2,722
Action Alternative B	357	1,402	963	2,722
Action Alternative C	434	1,174	1,114	2,722
Action Alternative D	710	1,402	610	2,722

most treatments occurring in old-growth stands address stands with a high risk of losing the old-growth status. Focusing treatments in these stands allows DNRC to not only meet its objective of promoting healthy and biologically diverse forest within the project area and Swan River State Forest, but also captures value that would otherwise be lost to mortality. While many of these stands would no longer be classified as old growth following treatment, a high likelihood is that in the near future, even without treatment, these stands would no longer be classified as old growth.

Old-Growth Attributes

The diversity of old-growth definitions and the relative importance of old growth as a specific stand condition led DNRC to develop a tool to analyze and understand old growth. This tool indexes attribute levels in stands using DNRC's SLI and is called the Full Old Growth Index (FOGI).

The old-growth attributes making up FOGI are:

- number of large live trees,
- amount of coarse woody debris,
- number of snags,
- amount of decadence,
- multistoried structures,
- gross volume, and
- crown density.

Old-growth quality depends on the type of old growth, associated wildlife species being considered, where old growth exists on the landscape, and other factors that do not lend themselves to consistent or meaningful quantification. For the purposes of this analysis, we are using attribute levels (FOGI) as an indicator of quality, but are also cognizant that quality is too nebulous a concept for a quantitative analysis. Using FOGI provides an indication of the relative levels of 'old growthedness'. FOGI could be construed as providing an indication of old-growth quality, but is more appropriately considered an indication of overall attribute levels. So, while the highest attribute levels may be high quality for some wildlife species and old-growth types (for example mixed-conifer old growth, which tends to exist in a dense and structurally diverse condition), other species and types are highest quality at relatively lower attribute levels, in particular the ponderosa pine type (which tends to exist in a more open condition that is less structurally diverse). Therefore, the analysis focuses on quantitative or qualitative assessment of attribute levels rather than relying on the value-laden concept of quality.

Indicators of Old-Growth Attributes

We recognize that our desired management strategy under the SFLMP is to retain, in reasonable proportions, stands that contain all the naturally occurring combinations of attributes, including those associated with old-growth stands. Thus, in this section, we display current conditions with regard to attributes often associated with old growth. The attributes displayed are number of large live trees, amounts of coarse woody debris and snags, vigor, crown density, stand structure, and gross volume per acre.

Lacking are surveys specifically oriented to clearly identify all stand characteristics that would characterize old growth. However, indices were derived from data in our SLI that summarized the abundance of 4 attributes that often, but not always, characterize stands in the latter stages of development: large live trees, snags, down coarse woody debris, and decadence among live trees (classified as vigor). In each case, a standard step-by-step procedure was used that integrated information from more than one field in the SLI to produce a single index number (*TABLE V-12– OLD-GROWTH INDEX ATTRIBUTES AND POINT ASSIGNMENTS*). Briefly, the large-tree index measures the relative abundance of trees that are more than 21 inches dbh. The snag index measures the relative abundance of large dead trees, with greater weight given to larger-diameter snags, but equal weight given to snags by their species and other characteristics. Similarly, the index of down coarse woody debris measures the relative abundance of down woody material, with greater weight given to the logs of larger diameter, regardless of species or degree of rot. The vigor of old-growth stands is discussed as a surrogate for stand decadence. Stands with higher vigor ratings are those with lower decadence and vice versa.

In each case, only 4 categories of abundance were used, which corresponded roughly to 4 adjectives:

TABLE V-12– OLD-GROWTH INDEX ATTRIBUTES AND POINT ASSIGNMENTS

ATTRIBUTES[1]	0	1	2	3	4	5	6	7
Number of large trees	None		Few		Some		Lots	
Coarse woody debris	None	Few	Some	Lots				
Number of snags	None	Few	Some	Lots				
Decadence	None	Little	Some	Lots				
Structure	Single-storied	Two-storied	Multistoried					
Gross Mbf	Less than 4	4-6	7-9	10-12	13-15	16-20	21-25	26+
Crown density index (percent)	Poor 0 to 39		Medium 40 to 69		Well 70+			

[1]The blank spaces are not applicable, see attachment V-1 for attribute assignments

- none
- few (or little)
- some (i.e., a typical amount for a stand of that forest type and age, neither particularly few nor many)
- many (or much)

The crown density index is measured as the percentage of crown cover reflexed as poor (0 through 39), medium (40 through 69), and well (70 plus).

The FOGI process assigns an index rating to each old-growth attribute that, when summed, indicates its total score, or old-growth index, for the stand. For analysis purposes, these scores can be grouped into low, medium, and high categories. This provides an indication of the condition of the stand in regards to attributes often associated with old growth. These indices do not necessarily indicate old-growth quality, but can be used to compare and classify a collection of older stands across the landscape. The expected variation between covertypes is based on numerous factors, including habitat-type groups, tree species, covertypes, elevations, past-management activities, and proximity to roads. Many of these attributes relate to wildlife habitat and are discussed under *WILDLIFE ANALYSIS*. *TABLE V-13 - FOGI CLASSIFICATION FOR THE PROJECT AREA AND POSTHARVEST AMOUNTS* shows the current amounts of old-growth acres in each of the FOGI classifications and the effects of the action alternatives.

Large Trees per Acre

TABLE V-14 - CURRENT AND POSTHARVEST AMOUNTS OF LARGE TREES PER ACRE IN OLD-GROWTH STANDS IN THE PROJECT AREA shows the relative abundance of large trees in old-growth stands. As shown, approximately 84.1 percent of all old-growth stands are in the highest abundance category for numbers

TABLE V-13 – FOGI CLASSIFICATION FOR THE PROJECT AREA AND POSTHARVEST AMOUNTS

FOGI CLASSIFICATION	CURRENT ACRES	ACTION ALTERNATIVE		
		B	C	D
Low	0	183	105	0
Medium	313	91	116	243
High	2,409	1,485	1,387	1,869
Totals	*2,722*	*1,759*	*1,608*	*2,112*

TABLE V-14- CURRENT AND POSTHARVEST AMOUNTS OF LARGE TREES PER ACRE IN OLD-GROWTH STANDS IN THE PROJECT AREA

LARGE TREES	CURRENT	ALTERNATIVE		
		B	C	D
Lots	2,289	1,434	1,297	1,800
Some	400	292	278	279
Few	33	33	33	33
Totals	*2,722*	*1,759*	*1,608*	*2,112*

of large live trees, with 14.7 percent having 'SOME', and 1.2 percent having 'FEW'.

This figure also shows the changes in the percent of stands with large trees on a per-acre basis. Some stands would no longer meet the old-growth definition and are not included, but for those that are included, the change is very slight. Action Alternative D retains the highest proportions of large trees in the 'LOTS' categories, while the other alternatives show greater reductions in the numbers of large live trees.

Amounts of Coarse Woody Debris

Coarse woody debris is measured by the number of pieces present along transect lines through a stand. The pieces are measured for diameter and grouped in ranges such as 6 to 10, 11 to 15, 16 to 20, and so on. The volume or tons per acre of coarse woody debris is also recorded. The SLI database contains information on coarse woody debris primarily for older stands on Swan River State Forest. The older stands (100+ years) show various quantities and sizes of coarse woody debris. Stands with the most pieces and the greatest tons per acre are between 150 to 200 years old, but are not necessarily old growth. For the project area, the maximum tons per acre are 93.6, the minimum is 0, and the average for the old-growth stands in the project area is 26.1 tons per acre. Stand data information describing the number of pieces per grouped range, number of small pieces, number of large pieces, level of decay, and tons per acre is available in the project file.

TABLE V-15 - CURRENT AND POSTHARVEST LEVELS OF COARSE WOODY DEBRIS IN OLD-GROWTH STANDS IN THE PROJECT AREA shows the relative abundance of down coarse woody debris in old-growth stands. As with the snag numbers, salvage operations are expected to reduce the amount of coarse woody debris in old-growth stands across Swan River State Forest, resulting in a preponderance of stands in the "SOME" and "FEW" categories.

Snags per Acre

TABLE V-16 - CURRENT AND POSTHARVEST AMOUNTS OF SNAGS PER ACRE IN OLD-GROWTH STANDS IN THE PROJECT AREA shows the relative abundance of large snags in old-growth stands. The preponderance of stands has some or lots of large snags. The 'FEW' category represents DNRC's minimum for snag retention postharvest. The amount of snags fluctuates across the landscape due to salvage harvesting, which reduces the

TABLE V-15 - CURRENT AND POSTHARVEST LEVELS OF COARSE WOODY DEBRIS IN OLD-GROWTH STANDS IN THE PROJECT AREA

COARSE WOODY DEBRIS	CURRENT	ALTERNATIVE		
		B	C	D
Lots	426	272	318	331
Some	995	576	372	718
Few	1,261	893	900	1,045
None	40	18	18	18
Totals	*2,722*	*1,759*	*1,608*	*2,112*

TABLE V-16 -CURRENT AND POSTHARVEST AMOUNTS OF SNAGS PER ACRE IN OLD-GROWTH STANDS IN THE PROJECT AREA

SNAGS	CURRENT	ALTERNATIVE		
		B	C	D
Lots	2,058	1,255	1,130	1,556
Some	624	464	438	516
Few	40	40	40	40
Totals	2,722	1,759	1,608	2,112

numbers and continued mortality from insect and disease activities, which increases snag amounts.

Decadence or Stand Vigor of Old Growth

The vigor of old-growth stands is used to indicate relative decadence. Old-growth stands of low vigor are more likely to have more snags and greater amounts of large down woody debris than would be expected with stands of high vigor. The 4 generally recognized vigor classes are:

- *Vigor 1 - Full Vigor* – Forests have an open canopy and growth is optimal. An example of a stand in this class is young, immature, and probably in the seedling or sapling stage. Currently, no acres of old growth within the project area are at full vigor.
- *Vigor 2 – Good to Average Vigor* – Stand canopies are mostly closed with crown ratios (the vertical height of a tree's crown compared with the total vertical height of the tree) between 33 and 50 percent. Growth rates exceed mortality in these stands. An example of a stand in this class would be young, merchantable sawtimber. Old-growth stands of good to average vigor represent 82 acres in the project area.
- *Vigor 3 – Just Below Average to Poor Vigor* – Stand canopies are tightly closed with crown ratios less than 33 percent. Growth and mortality rates are nearly balanced. An example of a stand in this class would be an old stand of merchantable sawtimber. Old-growth stands of just below average to poor vigor occupy 1,320 acres in the project area.
- *Vigor 4 - Poor Vigor* – Stands are similar to the just below average to poor vigor class, but generally are in a decadent condition caused by competing vegetation, insects, diseases, and/or old age. Typically, mortality rates exceed growth rates. Old-growth stands of poor vigor occupy 1,320 acres in the project area; all are at risk to insects and diseases.

TABLE V-17 - ACRES OF CURRENT AND POSTHARVEST DISTRIBUTION OF VIGOR CLASSIFICATIONS FOR OLD-GROWTH STANDS IN THE PROJECT AREA shows the vigor classes, by percentage for old-growth stands.

Stand Structure of Old Growth

The structure of forested stands indicates one characteristic often associated with old growth, namely whether or not the stand is in a multistoried condition. The multistoried condition arises when a stand has progressed through succession to the point that shade-tolerant species are advancing into the overstory. In Montana, this condition most commonly occurs when shade-tolerant

TABLE V-17 – ACRES OF CURRENT AND POSTHARVEST DISTRIBUTION OF VIGOR CLASSIFICATIONS FOR OLD-GROWTH STANDS IN THE PROJECT AREA

VIGOR	CURRENT	ACTION ALTERNATIVE		
		B	C	D
Full	0	0	0	0
Good to average	82	265	106	82
Just below average to poor	1,320	1,137	1,068	1,320
Poor	1,320	357	434	710
Totals	*2,722*	*1,759*	*1,608*	*2,112*

species are replacing a shade-intolerant overstory, but can also occur when a stand is already dominated by large, old, shade-tolerant species and, through gap replacement, the regeneration that occurs is also shade tolerant. In both cases, the time since a major disturbance tends to be long, helping to create many of the attributes important in old growth. *TABLE V-18 - ACRES OF CURRENT AND POSTHARVEST STRUCTURES BY ALTERNATIVE FOR OLD-GROWTH STANDS IN THE PROJECT AREA* displays the current conditions for stand structure of old growth and the postharvest effects of each action alternative. As shown, the vast majority of old-growth stands have multiple canopy levels.

Gross Volume per Acre

Another attribute of old-growth stands often deemed important and for which distributions can be quantified and effects assessed is a measure of density, or stocking. In this case, the stand's gross board-foot volume per acre is used (*TABLE V-19 – CURRENT AND POSTHARVEST AMOUNTS OF GROSS VOLUME PER ACRE (MBF) IN OLD-GROWTH STANDS IN THE PROJECT AREA*). Higher volumes indicate more densely stocked stands. One value of this measure is that effects of ingrowth and lack of wildfires are minimized because only trees larger than 9 inches dbh are included. Thus, this becomes another measure through which impacts on the character of old-growth stands can be measured.

TABLE V-18 – ACRES OF CURRENT AND POSTHARVEST STRUCTURES BY ALTERNATIVE FOR OLD-GROWTH STANDS IN THE PROJECT AREA

STRUCTURE	CURRENT	ACTION ALTERNATIVE		
		B	C	D
	ACRES			
Single-storied	23	0	0	0
Two-storied	196	22	117	196
Multistoried	619	569	689	575
Heterogeneous	284	284	284	284
Classic uneven-aged	1,600	884	518	1,057
Totals	*2,722*	*1,759*	*1,608*	*2,112*

TABLE V-19 – CURRENT AND POSTHARVEST AMOUNTS OF GROSS VOLUME PER ACRE (MBF) IN OLD-GROWTH STANDS IN THE PROJECT AREA

GROSS VOLUME PER ACRE (Mbf)	CURRENT	ALTERNATIVE		
		B	C	D
	(ACRES)			
26+	1,021	853	937	914
21 to 25	1,277	593	277	822
16 to 20	294	104	263	280
13 to 15	60	26	26	26
10 to 12	0	183	105	0
4 to 6	70	0	0	70
Totals	*2,722*	*1,759*	*1,608*	*2,112*

As shown, a very small proportion (about 2.6 percent) of old-growth stands in the project area contains less than 10 Mbf per acre. Approximately 37.5 percent of old-growth stands contain over 26 Mbf per acre, approximately 46.9 percent contain 21 to 25 Mbf per acre, approximately 10.8 percent contain 16 to 20 Mbf per acre, and approximately 2.2 percent contain 13 to 15 Mbf per acre.

Crown Density Index

Crown density, as denoted by crown cover, has 5 categories:

- well stocked (greater than 70 percent),
- medium stocked (40 to 69 percent),
- poorly stocked (less than 39 percent),
- nonstocked, or
- nonforested.

Currently, 2,574 acres (94.5 percent) of the old-growth stands in the project area are well-stocked and 149 acres (5.5 percent) of the old-growth stands in the project area are medium-stocked (*TABLE V-20 – ACRES OF CURRENT AND POSTHARVEST CROWN DENSITY/COVER FOR OLD-GROWTH STANDS IN THE PROJECT AREA).*

TABLE V-20-ACRES OF CURRENT AND POSTHARVEST CROWN DENSITY/COVER FOR OLD-GROWTH STANDS IN THE PROJECT AREA

CROWN DENSITY/ COVER	CURRENT	ALTERNATIVE		
		B	C	D
	ACRES			
Well stocked	2,573	1,486	1,406	1,998
Medium stocked	149	273	202	114
Totals	*2,722*	*1,759*	*1,608*	*2,112*

ENVIRONMENTAL EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Old Growth***

In the short term, existing old-growth stands would continue to experience substantial mortality of large Douglas-fir, grand fir, and western white pine trees, increasing the snag and down woody debris components of those stands. Some stands may no longer be in the old-growth classification as a result of the gradual or sudden loss of many large trees due to Douglas-fir bark beetles, mountain pine beetles, dwarf mistletoe, white pine blister rust, drought, competition, etc. These factors can reduce the number of large, live trees below the minimum described in *Green et al. (1992)*. Over the long term, existing old growth would continue to age and become more decadent.

Not harvesting in old-growth stands would continue the existing risk of stand-replacement fires that would likely consume portions of the old-growth stands in their paths.

Existing open roads would continue to provide access to firewood gatherers, reducing the development of snags and coarse woody debris on those sites.

Over time and barring large-scale disturbances, old-growth attribute levels would increase on most covertypes as climax species mature, decadence increases, and trees die and fall, creating more snags and large woody debris. However, the large-tree component is likely to be reduced over time as large shade-intolerant species die and are replaced by smaller shade-tolerant species with a lesser chance of becoming large.

These same stands would also reach a point where the old-growth-attribute levels decrease. As large trees continue to age and eventually die, some stands would no longer meet the old-growth definition.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Old Growth***

The proposed harvest treatments for all of the action alternatives would affect old growth, as illustrated in *TABLE V-10 CURRENT OLD-GROWTH ACRES AND POSTHARVEST ACTION ALTERNATIVE EFFECTS BY FOREST COVERTYPE FOR SWAN RIVER STATE FOREST* and *TABLE V-21 - ACRES OF OLD GROWTH PROPOSED FOR HARVESTING BY COVERTYPE.* Old-growth stands would be harvested with seedtree, seedtree-with-reserves, and variable thinning treatments.

The main objectives for entering these old-growth stands are to treat current high-risk stands or prevent a future high-risk status through removal of insect-infested and disease-infected trees, maintenance of historical covertypes, and removal or reduction of shade-tolerant species. The variable thin units may be classified as old growth following harvesting; postharvest data collection in particular stands would determine their classification.

With Action Alternative B, approximately 963 acres, or 73.0 percent, of high-risk old growth in the project area would receive seedtree or seedtree-with-reserves treatments. With Action Alternative C, approximately 886 acres, or 67.1 percent, of high-risk old growth in the project area would receive seedtree or seedtree-with-reserves treatments. With Action Alternative D, approximately 610 acres, or 46.2 percent, of high-risk old growth in the project area would receive seedtree or seedtree-with-reserves treatments (see *TABLE V-11 – CURRENT AND*

TABLE V-21 - ACRES OF OLD GROWTH PROPOSED FOR HARVESTING BY COVERTYPE

			MIXED CONIFER	WESTERN LARCH/ DOUGLAS-FIR	WESTERN WHITE PINE	SUBALPINE FIR	TOTALS
Current conditions in the project area			1,688	248	719	67	2,722
Action Alternative	B	Proposed for harvest	433	171	542	0	1,146
		Postharvest	1,319[1]	172[1]	201[1]	67	1,759[1]
	C	Proposed for harvest	548	38	633	0	1,219
		Postharvest	1,221[1]	210	110[1]	67	1,608[1]
	D	Proposed for harvest	223	0	387	0	610
		Postharvest	1,465	248	332	67	2,112

[1] *Totals reflect acres treated that retained old-growth status postharvest as well as acres treated that did not retain old-growth status postharvest.*

POSTHARVEST AMOUNTS OF HIGH-RISK OLD-GROWTH STANDS).

The primary effects to old growth would be the removal of stands from their old-growth classification or a reduction of attribute levels associated with old-growth stands. The old-growth attributes that would be affected include:

- ***Number of Trees***

  Large, live trees would be removed if they are dying from insect or disease attacks or to provide openings for regeneration. Seedtree and seedtree-with-reserves units would retain 6 to 10 trees per acre, with emphasis given to the larger-diameter trees. Health, vigor, cone production, and other factors would be considered when selecting trees for retention purposes. Variable-thin units would retain a minimum of 40-percent canopy cover, with priority given to the healthier, better-formed individuals in the stand. The seedtree and seedtree-with-reserves treatments would not retain sufficient large live trees to meet DNRC's old-growth definition, while variable thinning harvests are expected to meet the definition (see *TABLE V-14 - CURRENT AND POSTHARVEST AMOUNTS OF LARGE TREES PER ACRE IN OLD-GROWTH STANDS IN THE PROJECT AREA*).

  It should be noted that the Department's old-growth definition provides an objective, numerical threshold for labeling a stand as old growth. Because of this objectivity, some stands may remain old growth despite having had some trees harvested because the threshold defining old growth is still exceeded. Thus, the apparent anomaly occurs where recently harvested stands could retain sufficient levels of important attributes to remain old growth despite the harvesting that occurred. The definitions also result in the possibility that some acres are shifted from one type of old growth to another because, once again, they would retain sufficient levels of attributes to meet the definition, but shifts in species representation cause a shift in the 'type' of old growth.

  Action Alternative D would retain the highest proportion of large trees in the 'LOTS' category, while the other alternatives show greater reductions in the number of large live trees.

- ***Coarse Woody Debris***

  Slash would be piled and burned or otherwise treated on site. Stands would retain 15 to 20 tons of coarse woody debris postharvest. The seedtree or seedtree-with-reserves harvest units may, where feasible, be broadcast burned. The reduction in total acres in the chart reflects the stands' lack of old-growth status postharvest (see *TABLE V-15 - CURRENT AND POSTHARVEST LEVELS OF COARSE WOODY DEBRIS IN OLD-GROWTH STANDS IN THE PROJECT AREA*).

- ***Number of Snags***

  The minimum snag retention per acre for all units would consist of 2 trees, 21 inches dbh or greater; if no trees that large are present, the next largest trees would be retained. In addition, 2 snag-recruit trees per acre, 21 inches dbh or greater, would be retained. *TABLE V-16 - CURRENT AND POSTHARVEST AMOUNTS OF SNAGS PER ACRE IN OLD-GROWTH STANDS IN THE PROJECT AREA* illustrates the postharvest levels of snags per acre. The change in the percentage of stands with the minimum requirements for retention is minor. Over 99 percent of old-growth stands would still have 2 or more snags per acre. Based on estimates of historical snag numbers (see *WILDLIFE ANALYSIS*), postharvest snag levels well exceed average historical conditions with over double the expected amount of large snags.

- ***Decadence or Stand Vigor***

TABLE V-17 – ACRES OF CURRENT AND POSTHARVEST DISTRIBUTION OF VIGOR CLASSIFICATIONS FOR OLD-GROWTH STANDS IN THE PROJECT AREA illustrates the changes that would take place following harvesting operations. Stands with full vigor would be increased; however, these stands fall out of old-growth classification and are not shown. The treated stands would have reduced density and a more-open canopy, which would allow more light in and free up nutrients in the soil for utilization by the residual trees. Postharvest stands still classified as old growth would shift from the *Just below average to poor* or *Poor* vigor to the *Good to average* vigor classification.

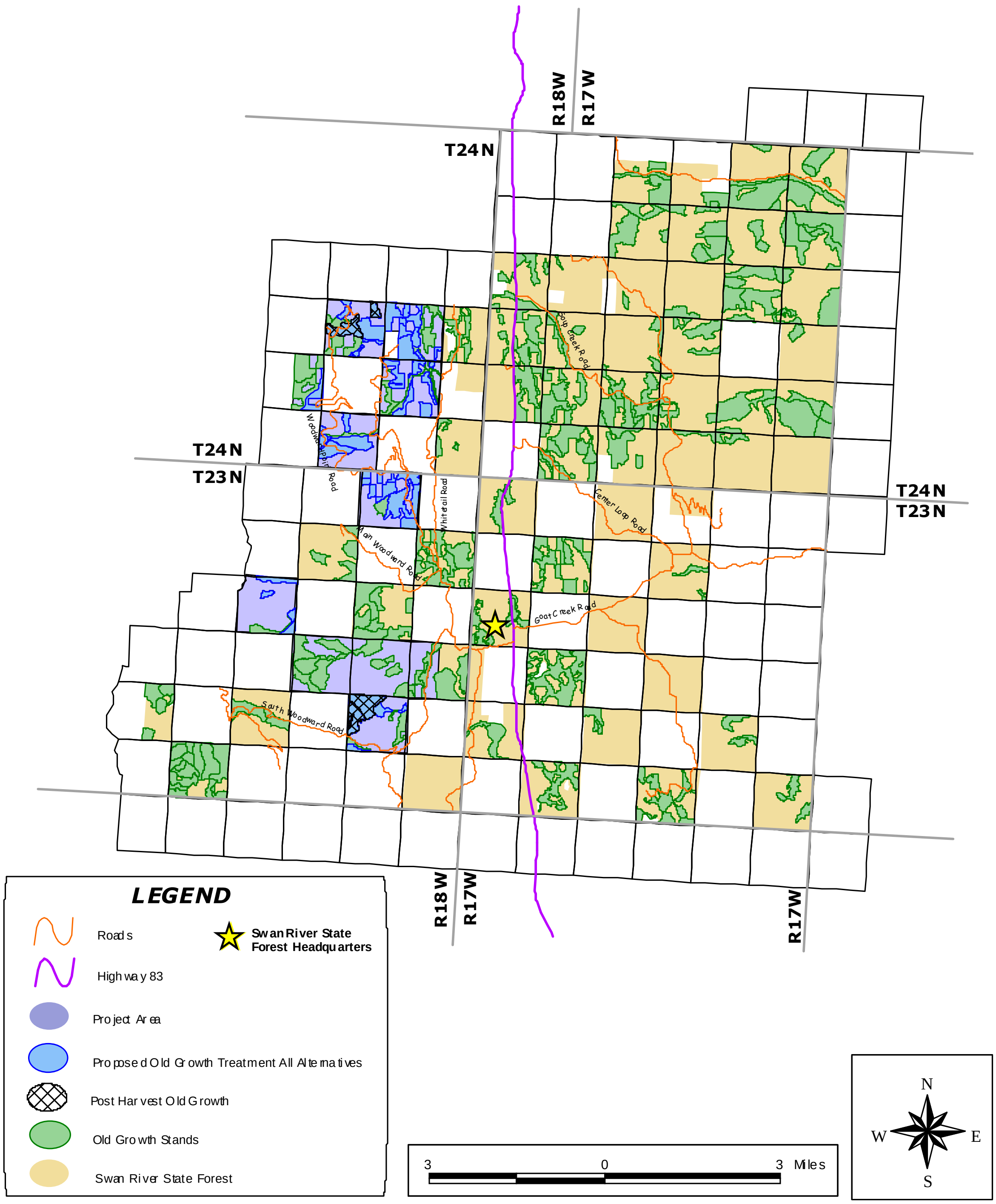
- ***Stand Structure***

This category would improve or remain at existing levels for harvested stands. Stand structures in seedtree and seedtree-with-reserves units would be converted to single-storied stand structures following harvesting. Variable-thin units would be converted to multistoried stand structures following harvesting. Many of the treatments are regeneration-type harvests, which completely change the stand structures and remove the stands from old-growth classification. Only one distinct canopy level would exist following regeneration harvesting. For stands that receive a partial treatment, 2 or more distinct canopy layers would remain and this would allow the retention of old-growth status. *TABLE V-18 - ACRES OF CURRENT AND POSTHARVEST STRUCTURES BY ALTERNATIVE FOR OLD-GROWTH STANDS IN THE PROJECT AREA* illustrates the slight changes in structure from multistoried stands to single- or two-storied stands. Also reflected in the figure is the removal of stands that no longer meet the old-growth definition.

- ***Volume per Acre (Mbf)***

TABLE V–19 – CURRENT AND POSTHARVEST AMOUNTS OF GROSS VOLUME PER ACRE (MBF) IN OLD-GROWTH STANDS IN THE PROJECT AREA illustrates the effects to gross volume per acre following harvesting operations. Old-growth stands with less than 10 Mbf per acre would vary from 3.3 to 10.4 percent of the remaining old growth in the project area. Stands that have 13 to 15 Mbf per acre would vary from 1.2 to 1.8 percent of the project area. Stands that have 16 to 20 Mbf per acre would vary from 5.9 to 16.4 percent of the project area. Stands that have 21 to 25 Mbf per acre would vary from 17.2 to 38.9 percent of

FIGURE V-11 - CURRENT OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST



the project area, and stands that have more than 26 Mbf per acre would vary from 43.3 to 58.3 percent; thus, creating a larger proportion of residual old-growth stands with large volumes per acre.

- ***Crown Density***

  Stocking levels in all treated stands would be reduced and is reflected through crown-cover percentages. The stocking levels in the variable-thin units would be approximately half the current levels, but would retain a minimum of 40-percent crown cover. Stocking levels for seedtree and seedtree-with-reserves units would be approximately 10 percent of current levels and retain less than 40-percent crown cover (these stands would not be old-growth postharvest). *TABLE V-20 - ACRES OF CURRENT AND POSTHARVEST CROWN DENSITY/ COVER FOR OLD-GROWTH STANDS IN THE PROJECT AREA* illustrates the changes in crown cover through harvest treatments. The variable-thin treatment would shift well-stocked stands into the medium-stocked stand category. Seedtree or seedtree-with-reserves treatments would remove the stands from the old-growth status as reflected in the chart.

  All of the action alternatives would harvest timber in or near old-growth stands and create more abrupt stand edges. Some mature stands not yet classified as old growth could be considered old growth in the future. Commercial or variable-thin harvests within these mature stands would increase the diameter growth rates of remaining trees and, in some cases, may hasten the development of old-growth attributes, especially large-diameter trees.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Old Growth***

  Current levels of old-growth acres would not change in the short term. As stands continue to mature and large trees eventually die, some stands may no longer meet the old-growth definition. Ongoing data collection of stands may change the amount of acres classified as old growth. The Swan River State Forest salvage program has completed limited harvesting in old growth on the High Blow '02, Big Blowdown, Cilly Bug, Rock Squeezer, Red Ridge, Lucky Logger, and Fridge salvage sales. The Three Creeks Timber Sales (1, 2, 3, and Small Lost), which contains old-growth stands, are slated to be harvested in Summer 2008 through Winter 2009.

  It should be noted that timber stands, whether harvesting occurs or not, may be reinventoried or reindexed in regard to adjustments of stand boundaries, and a more intensive inventory may change the old-growth status.

  Past road construction, timber harvests, wildfires, and general site characteristics have led to the current amount of old-growth characteristics in the entire area. The salvage harvesting would not alter old-growth designation, but would reduce the numbers of large snags and coarse woody debris and, potentially, decrease stand decadence. Future timber sales and thinning projects would likely continue to take place in the analysis area. If additional management projects were proposed, the MEPA process would be implemented. The cumulative effects to old-growth amounts and distributions due to previous activities on USFS as well as privately-held ground, including Plum Creek property and small, private landholdings adjacent to Swan River State Forest and the project area, are difficult to quantify because little is known about the total amount of old growth on these ownerships and old-growth stand approximations were not possible by analyzing aerial photograph. The retention of old-growth appears to have occurred on some USFS ground. Appearance seems to show that on Plum Creek ownership old stands have been retained primarily along creeks and other water features, while younger stands are in place elsewhere. The stands of small, private landowners appear as a mosaic, which results in a variety of age classes and inexact amounts of old growth amongst multiple ownerships

- ***Cumulative Effects of Action Alternatives B, C, and D to Old Growth***

Action Alternative B would harvest approximately 1,146 acres of old growth, which would reduce the amount of old-growth acres in the project area by 35.4 percent. Following harvesting operations, 963 acres would no longer meet old-growth criteria, while 183 acres would retain the old-growth classification. The amount of old growth remaining on Swan River State Forest would be 11,153 acres, and the proportion of acreage classified as old growth would be 28.6 percent.

Action Alternative C would harvest approximately 1,219 acres of old growth, which would reduce the amount of old-growth acres in the project area by 40.9 percent. Following harvesting operations, 1,114 acres would no longer meet old-growth criteria, while 105 acres would retain old-growth classification. The amount of old-growth acres remaining on Swan River State Forest would be 11,002 acres and the proportion of acreage classified as old growth would be 28.3 percent.

Action Alternative D would harvest approximately 610 acres of old growth, which would reduce the amount of old-growth acres in the project area by 22.4 percent. Following harvesting operations, 610 acres would no longer meet old-growth criteria. The amount of old growth remaining on Swan River State Forest would be 11,506 acres, and the proportion of acreage classified as old growth would be 29.6 percent. *TABLE V-22- OLD-GROWTH FOGI ATTRIBUTE CLASSIFICATION CHANGES PREHARVEST AND POSTHARVEST BY ALTERNATIVE* clearly outlines the preharvest and postharvest attributes of each unit proposed for treatment.

Recognizing that the amounts and distributions of all age classes would shift and change over time, the amount of old growth remaining is within an expected range of natural variation.

TABLE V-22-OLD-GROWTH FOGI ATTRIBUTE CLASSIFICATION CHANGES PREHARVEST AND POST HARVEST BY ALTERNATIVE

							EFFECTS BY ACTION ALTERNATIVE						
							B			C			D
CURRENT STAND NUMBER	OLD-GROWTH TYPE	HARVEST PRESCRIPTION	STAND ACRES	PREHARVEST INDEX NUMBER	CURRENT FOGI CLASS	HIGH RISK	INDEX NUMBER	CLASS	OLD-GROWTH POSTHARVEST	INDEX NUMBER	CLASS	OLD-GROWTH POSTHARVEST	OLD-GROWTH POSTHARVEST
230206	WL/ DF	ST	38	26	High	Yes			No			No	
230208	WWP	STR	139	27	High	Yes			No			No	
230209	MC	ST	11	26	High	Yes			No			No	
230210	MC	ST	13	14	Medium	Yes			No			No	
230213	MC	ST	14	18	Medium	Yes			No			No	
230215	MC	ST	17	20	Medium	Yes			No			No	
230220	WWP	ST	36	27	High	Yes			No			No	No
230221	WWP	ST	49	27	High	Yes			No			No	
231609	MC	STR	33	22	High	Yes			No				No
231617	MC	ST	12	24	High	Yes			No				
231618	WL/ DF	ST	38	27	High	Yes			No				
232608	WL/ DF	VT	95	22	High	No	12	Low	Yes				
232609	MC	ST	28	28	High	Yes			No				
232611	MC	ST	7	23	High	Yes			No				
232619	MC	ST	16	26	High	Yes			No				
232625	MC	VT	64	18	Medium	No	10	Low	Yes				
242205	WWP	STR	79	26	High	Yes			No			No	No
242208	MC	ST	26	26	High	No						No	
242209	MC	VT	81	26	High	No				10	Low	Yes	
242213	WWP	VT	24	35	High	No	12	Low	Yes	12	Low	Yes	
242215	WWP	ST	10	21	High	Yes			No			No	
242219	WWP	ST	10	24	High	Yes			No			No	No
242310	MC	ST	33	27	High	No						No	
242312	WWP	ST	33	27	High	Yes			No			No	
242316	MC	ST	71	17	Medium	Yes			No			No	
242317	MC	STR	74	23	High	Yes			No			No	No
242319	WWP	ST	8	22	High	Yes			No			No	
242322	WWP	ST	9	26	High	Yes			No			No	No
242324	WWP	ST	22	27	High	Yes			No			No	No
242615	WWP	ST	5	27	High	No						No	
242620	WWP	ST	48	26	High	No						No	

VEGETATION ANALYSIS

CURRENT STAND NUMBER	OLD-GROWTH TYPE	HARVEST PRESCRIPTION	STAND ACRES	PREHARVEST INDEX NUMBER	CURRENT FOGI CLASS	HIGH RISK	EFFECTS BY ACTION ALTERNATIVE						
							B			C			D
							INDEX NUMBER	CLASS	OLD-GROWTH POSTHARVEST	INDEX NUMBER	CLASS	OLD-GROWTH POSTHARVEST	OLD-GROWTH POSTHARVEST
242621	WWP	ST	31	26	High	Yes			No			No	
242622	WWP	ST	38	27	High	No						No	
242626	MC	ST	57	26	High	Yes						No	No
242802	MC	ST	52	27	High	Yes			No			No	
243401	MC	STR	78	25	High	No						No	
243407	WWP	STR	70	25	High	Yes			No			No	No
243408	WWP	ST	22	19	Medium	Yes			No			No	No
243414	MC	ST	21	19	Medium	Yes			No			No	No
WL – western larch			*DF – Douglas-fir*				*WWP – western white pine*				*MC – mixed conifer*		

AGE AND COVERTYPE PATCH SIZE

Issue: The proposed activities may affect patch size and shape through tree removal.

EXISTING ENVIRONMENT

- **Age Patches**

Traditionally, forest management has focused on forest stands, which are typically defined as units with similar characteristics of tree species, tree sizes, and stocking levels. However, some understanding of the environment can be gained by examining different groupings of stands according to fewer characteristics such as age class or covertype. For example, the size of patches of equivalent age is one way to assess effects of management activities to the forested landscape. Age-class patches broadly reflect disturbance in the natural environment and the additional influence of harvesting and associated activities in the managed environment.

Forests change over time. Tracking the changes from historical to current conditions can indicate the effects of management and whether the direction of change is desirable. Assessing historic forest conditions is filled with challenges, such as a lack of actual data or, even when data is available, compatibility with current information. DNRC has maps of an inventory conducted in the 1930s that provide a general baseline for age (and covertype) patches for Swan River State Forest and the project area. The data does not provide for a seamless comparison between historic and current conditions due to differences in mapping procedures, primarily an 8-fold difference in minimum map-unit size (40 acres historically and 5 acres currently). The reduced minimum map-unit size results in many more patches of a smaller average size, even when applied to the same forest at the same point in time. However, the data does represent the best historic information available; therefore, the data is presented with the caveats mentioned in this paragraph.

This analysis focuses on stand age classes. The oldest age class also encompasses all old-growth stands. However, old growth would represent only a portion of all old-age stands, as not all old stands would meet the large-tree requirements that are part of DNRC's old-growth definition. Reconstructing the historic data to quantify patch characteristics of old growth is not possible, and, so, comparisons between historic and current conditions are not made. An analysis of the current patch characteristics of old growth and the effects of each action alternative are presented under *OLD-GROWTH PATCHES* further on in this analysis.

Historic data indicates that old-stand patches were large in both Swan River State Forest and the project area, with the patches being much larger in the Swan River State Forest than for the project area (*TABLE V-23 - HISTORIC AND CURRENT MEAN PATCH SIZES BY AGE CLASS FOR SWAN RIVER STATE FOREST AND THE PROJECT AREA* and *TABLE V-24 - CURRENT AND POSTHARVEST MEAN PATCH SIZES BY AGE CLASS FOR THE PROJECT AREA*). Historically, a single large old-stand patch, exceeding 14,000 acres, dominated Swan River State Forest (previous DNRC analysis indicates that large stands would be divided into many additional polygons using today's mapping protocols, even in the absence of any harvest-related activities). Other age patches were variable in size between the project level and Swan River State Forest. The expectation is that the project area would naturally have smaller patch size means due to imposing the artificial project area boundary onto some existing patches. On average, current age-class patches are much smaller than historically. Some of the decrease can be attributed to different map-unit minimums, but the data likely reflects a real reduction in mean patch sizes, as harvesting and roads have broken up some previously intact patches.

Current old-stand patches are smaller at the scale of the project area and Swan River State Forest than they were historically. Current Swan River State Forest old-stand patches are approximately 22 percent of the Swan River State Forest historic mean, and current project area old-stand patches are approximately 32 percent of the project area historic mean. At scales of both the project area and Swan River State Forest, the general trend appears to be a current patch size of all age classes, which is smaller than the historic mean.

TABLE V-23 - HISTORIC AND CURRENT MEAN PATCH SIZES BY AGE CLASS FOR SWAN RIVER STATE FOREST ANDTHE PROJECT AREA

AGE CLASS	SWAN RIVER STATE FOREST (ACRES)		PROJECT AREA (ACRES)	
	HISTORIC	CURRENT	HISTORIC	CURRENT
None	120.9	20.0	160.0	24.2
0 to 39 years	91.0	40.1	0.0	37.2
40 to 99 years	134.5	54.6	323.5	40.9
100 to old stand	76.4	53.3	0.0	58.3
Old stand	664.8	143.6	471.6	150.9
Overall	280.0			

TABLE V-24 – CURRENT AND POSTHARVEST MEAN PATCH SIZES BY AGE CLASS FOR THE PROJECT AREA

AGE CLASS	CURRENT PROJECT AREA (ACRES)	POSTHARVEST ACTION ALTERNATIVES		
		B (ACRES)	C (ACRES)	D (ACRES)
None	24.2	29.0	29.0	29.0
0 to 39 years	37.2	94.7	160.9	75.5
40 to 99 years	40.9	40.9	40.9	40.9
100 to old stand	58.3	59.5	46.8	46.8
Old stand	150.9	121.1	104.5	122.7
Overall	66.9	77.6	88.6	71.5

ENVIRONMENTAL EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A on Age Patch Size***

  Patch sizes would not be immediately affected. Over time, the forest would tend to homogenize, leading to larger patches of older stands, especially in the absence of significant fires or other disturbance events.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D on Age Patch Size***

  Within the project area, the mean old-stand patch size would be reduced to 121.1 acres (a 19.7-percent reduction) with Action Alternative B, 104.5 acres (a 30.7 percent reduction) with Action Alternative C, and 122.7 acres (an 18.7 percent reduction) with Action Alternative D. Action Alternative C would reduce the old-stand patch size the most, with the other action alternatives being roughly equivalent (*TABLE V - 24 – CURRENT AND POSTHARVEST MEAN PATCH SIZES BY AGE CLASS FOR THE PROJECT AREA*). Other age patches would be only marginally affected, except the 0-to-39-year age class, where mean patches would be increased with each action alternative, reflecting the effort to group stand-replacement harvesting near other previously harvested areas.

  Compared to current conditions, project-level effects indicate that Action Alternatives B, C, and D would slightly increase the mean size of age patches.

Cumulative Effects

- ***Cumulative Effects of All Alternatives on Age Patch Size***

  The current age class patch condition reflects the effects of natural disturbances and succession and the cumulative effects of previous activities by DNRC that have been completed and mapped. Overall, age patches for the entire forest and the project area are reduced from historic to current conditions. Cumulative effects of other harvests have been incorporated within the project area. Plum Creek and other private landowners within the project area have cumulatively increased the overall patch size of younger age classes through active management.

- **Old-Growth Patches**

  Old growth represents a subset of the old-stand age class. Old stands must contain a specified number and size of 'large' live trees to meet the old-growth definition; those large trees must also meet or exceed minimum age requirements. This analysis displays current patch-size characteristics of old growth and the effects of each alternative. This analysis does not present a corresponding analysis of historic old-growth patch characteristics because the data does not exist. Although it cannot be verified with observations of historic old-growth patch size, the reduction in patch size of old stands is expected to reflect a similar reduction in patch size of old-growth stands, but the absolute magnitude is unknown.

  Currently, the mean patch size of old-growth stands on Swan River State Forest is 115.0 acres (*TABLE V - 25 - CURRENT AND POSTHARVEST MEAN PATCH SIZES OF OLD GROWTH ON SWAN RIVER STATE FOREST AND IN THE PROJECT AREA*). In the project area, the mean

TABLE V - 25 - CURRENT AND POSTHARVEST MEAN PATCH SIZES OF OLD GROWTH ON SWAN RIVER STATE FOREST AND IN THE PROJECT AREA

SWAN RIVER STATE FOREST ACRES	CURRENT PROJECT AREA ACRES	ACTION ALTERNATIVE ACRES		
		B	C	D
115	124	99	70	96

old-growth patch size is 124.0 acres. Old-growth patches are about 80 percent the mean size of old-stand patches. The disparity between patch sizes of old stands and old growth reflects the addition of the large tree number, size, and age requirements.

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A on Old-Growth Patches***

  The patch size of old-growth stands would not be immediately affected. Over time, the effects to the old-growth patch size would be uncertain because the continued development of large live trees within old stands is unpredictable. If existing large live trees remain alive and new large trees develop in old-age stands, the mean patch size of old growth would be expected to increase. Conversely, if existing large live trees continue to die from effects of insects, diseases, and other factors, causing the stand to no longer meet the old-growth requirements specified by *Green et. al. (1992)*, and new large trees fail to develop because of overly dense stands, the mean patch size of old growth would be expected to decrease.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D on Old-Growth Patches***

  Each action alternative would reduce the mean patch size of old growth within the project area (*TABLE V-25 - CURRENT AND POSTHARVEST MEAN PATCH SIZES OF OLD GROWTH ON SWAN RIVER STATE FOREST AND IN THE PROJECT AREA*). Action Alternative C would reduce the mean patch size of old growth in the project area the most (54 acres), while Action Alternatives B and D would reduce the mean patch size of old growth in the project area by similar amounts (25 and 28 acres, respectively). At the scale of Swan River State Forest, old-growth patch sizes would also be reduced with each action alternative. Action Alternative C would result in the largest decrease (45 acres), while Action Alternatives B and D would result in decreases of 16 and 19 acres, respectively.

Cumulative Effects

- ***Cumulative Effects of All Alternatives on Old-Growth Patches***

  The current old-growth patch condition reflects the effects of natural disturbance and succession and the cumulative effects of previous activities by DNRC that have been completed and mapped.

Overall, old-growth patches for Swan River State Forest and the project area are reduced from historic to current conditions. Based on aerial photograph interpretation on a landscape basis, the cumulative effects to old-growth patch size due to previous activities on USFS as well as on privately held ground, including Plum Creek property and small, private landholdings adjacent to Swan River State Forest and the project area, have been an overall decrease in old-growth patch size through timber management.

- **Covertype Patches**

Historic data suggests mean covertype patch sizes are similar to age patch sizes, in part, due to large patches of old western larch/Douglas-fir, and to a lesser extent, western white pine and lodgepole pine, that dominated the forest and project area. As with mean age-class patch sizes, the differences in mapping protocols and, in particular, a different minimum map-unit size confound direct comparison and drawing clear conclusions. However, a real decrease in mean covertype patch size is expected due to the effects of harvesting and road building. The effects of succession confound the results and are reflected in the increased patch size of shade-tolerant types (mixed conifer and subalpine fir).

Overall, current covertype patches on Swan River State Forest and the project area are about one-quarter the size of the historic mean (*TABLE V-26 - HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR SWAN RIVER STATE FOREST* and *TABLE V-27 - HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR THE PROJECT AREA*). Currently, 3 of the project area

TABLE V-26 – HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR SWAN RIVER STATE FOREST

COVERTYPE CLASS	HISTORIC ACRES	CURRENT ACRES
Douglas-fir	0	25.2
Hardwood	28.5	17.8
Lodgepole pine	94.9	41.9
Mixed conifer	119.3	120.5
Noncommercial	85.2	N/A
Nonforested	32.9	17.4
Nonstocked	0	16.3
Ponderosa pine	127.3	41.5
Road	0	15.9
Subalpine fir	170.9	232.6
Water	25.6	22.0
Western larch/Douglas-fir	792.8	66.7
Western white pine	157.9	74.7
Overall	223.4	69.9

TABLE V-27 – HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR THE PROJECT AREA

COVERTYPE CLASS	HISTORIC ACRES	CURRENT ACRES
Douglas-fir	**0**	**14.4**
Lodgepole pine	**286.9**	**28.8**
Mixed conifer	**113.7**	**221.6**
Nonforested	**23.9**	**18.6**
Nonstocked	**0**	**7.6**
Ponderosa pine	**0**	**21.2**
Subalpine fir	**51.7**	**95.0**
Water	**0**	**20.5**
Western larch/Douglas-fir	**483.6**	**38.2**
Western white pine	**278.3**	**96.3**
Overall	**253.5**	**76.7**

covertype patches, mixed conifer, western white pine, and subalpine fir, are larger than those for Swan River State Forest. The remaining covertypes have smaller mean patch sizes in the project area than those for Swan River State Forest.

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A on Covertype Patches***

The covertype patch sizes would not be immediately affected; however, over time, diversity of habitats in terms of covertype patches would likely be reduced through forest succession. The result would be an increase in the mean size of patches dominated by shade-tolerant species as shade-intolerant species are excluded.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D on Covertype Patches***

Each action alternative would slightly reduce the overall average covertype patch size (*TABLE V-28 - PROJECT AREA POSTHARVEST MEAN PATCH SIZES BY COVERTYPE FOR EACH ALTERNATIVE*). Action Alternative B would reduce the mean patch size the most at a decrease of 7.6 acres, Action Alternative D the least at 0.9 acres. The greatest changes in patch sizes would occur in the mixed-conifer covertype. The mixed-conifer covertype patches would be reduced in size with each action alternative, Action Alternative C the most at 83.4 acres, and Action Alternative D the least at 41.1 acres. Other covertype patch sizes would be affected marginally or not at all by the project.

Cumulative Effects

- ***Cumulative Effects of All Alternatives on Covertype Patches***

The current covertype patch condition reflects previous activities by DNRC and natural disturbances and succession that have been completed and mapped. Overall, covertype patch sizes have been reduced from historic

TABLE V-28 - PROJECT AREA POSTHARVEST MEAN PATCH SIZES BY COVERTYPE FOR EACH ALTERNATIVE

COVERTYPE CLASS	CURRENT (ACRES)	ACTION ALTERNATIVE (ACRES)		
		B	C	D
Douglas-fir	14.4	63.0	14.4	63.0
Lodgepole pine	28.8	28.8	28.8	28.8
Mixed conifer	221.6	145.5	138.2	170.5
Nonforested	18.6	26.0	26.0	26.0
Nonstocked	7.6	13.2	13.2	13.2
Ponderosa pine	21.2	0.0	0.0	0.0
Subalpine fir	95.0	97.0	113.2	97.0
Water	20.5	20.5	20.5	20.5
Western larch/Douglas-fir	38.2	38.6	41.8	40.6
Western white pine	96.3	75.4	89.2	86.4
Overall	76.7	69.1	72.3	75.8

to current conditions. Other ongoing projects that have not been mapped to date would have a slight effect of decreasing patch sizes at the scale of Swan River State Forest. Within the project area, cumulative effects of other harvests have been incorporated. To determine the cumulative effects that USFS as well as Plum Creek and other private landowners within the project area have had on covertype patches through aerial photograph interpretation is difficult. Active management of forested lands suggests an increase in early seral species such as western larch and ponderosa pine. However, a lack of aggressive silvicultural practices may result in the retention of a mixed-conifer covertype postharvest.

FRAGMENTATION

Issue: The proposed activities may affect forest fragmentation through tree removal.

EXISTING ENVIRONMENT

Forest fragmentation refers to the breaking up of previously contiguous blocks of forest. Most often, the fragmentation is used in reference to the disruption of large contiguous blocks of mature forest caused by forest-management activities such as road building and timber harvesting. In relation to fragmentation, management activities begin by putting holes in the natural forested landscape (i.e. chunks of the forest are removed via harvesting, thus creating patches of nonmature forest within a background matrix of mature forest). As management continues and more harvesting takes place, the open patches created can become connected to other open patches, thus severing the previously existing connections between patches of mature forest. While the appropriate level of fragmentation for any particular forest is unknown, forests fragmented by management activities generally do not resemble natural forest conditions.

Forest fragmentation was analyzed using aerial photographs of the project area in ArcMap and querying the SLI. Aerial photographs provided a visual of past harvesting and current stand appearances such as stocking density and stand boundaries. Queries in the SLI and other layers provided information on contiguous areas of stands in the same age class, stocking levels, and stand densities. Alternative effects on the patch size of old-growth stands were also analyzed. Field visits helped to verify this information to establish increases or decreases in a given patch size.

Historically, wildfires burned with varying intensities and return intervals, and to different sizes across Swan River State Forest, which interacted with insect and disease activities and blowdown events to create a mosaic of forest covertypes and age classes. Today, forest management is the primary agent influencing fragmentation. Were intense fires to occur during extreme fire seasons, they would influence fragmentation across the landscape, as would insect and disease activities and blowdown events.

The majority of the project area is a matrix, or mosaic, of well-stocked older stands interspersed with younger stands resulting from past even-aged management harvesting activities; thus, the stands have been fragmented to some degree. Some man-made patches in harvest units range from 4 to 138 acres. However, some areas, such as Section 16, T24N, R18W, have not been entered previously and represent a continuous forest of stands uninfluenced by human activities, but of various stocking levels due to past insect infestations. Refer to *CONNECTIVITY ANALYSIS* in *WILDLIFE ANALYSIS* for an assessment of fragmentation effects on closed-canopied forests. Refer to the patch size of age classes, old growth, and covertype in this analysis for additional indications of the effects of forest fragmentation.

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Fragmentation***

  Forest fragmentation would not be directly affected by this alternative. Over time, and depending on an unknown future, indirect effects would include a reduction in fragmentation if additional harvesting is not imposed by management and existing patches of nonmature forests grow to maturity. Insects and diseases or fire, depending on the acreage involved and severity, could result in an increase in fragmentation as well.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Fragmentation***

  In the stands designated for regeneration harvesting, the primary effects would be creating a larger area of younger stands with a corresponding reduction in mature-forest stands. In the stands designated for seedtree or shelterwood with reserves, one or more patches (approximately 1.7 acres in size) would be left untreated, but the treatment would contribute to the fragmentation of mature forests. The intent would be to reduce the distance between open- and closed-canopied stands for wildlife security.

  The units designated for variable thinning would show less fragmentation of the canopy layer. Variable-thin units would be more similar to adjacent mature stands of timber than would the regeneration harvest units and, therefore, would not contribute to fragmentation. In the case where a variable-thin unit requires cable systems for harvesting or where opening the canopy surrounding a residual seral species tree is appropriate, the openings may resemble gaps created by small areas of crown torching that occur during low-intensity fires. However, these instances would not contribute to fragmentation.

Some regeneration harvest units are adjacent to past harvest areas and other proposed units, which would result in an enlargement of the younger age-class patches. The end result would be more of a blended geometric shape of larger regeneration units. The large size of regeneration units would result in larger mature stands in the future, thus, reducing fragmentation. However, future timber harvesting would result in additional fragmentation if existing mature timber patches received a regeneration harvest. The actual net effect on fragmentation would depend on future timber harvesting.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Fragmentation***

The Three Creeks Timber Sales (1, 2, 3, and Small Lost), as well as previous management activities, such as South Woodward and Goat Squeezer timber sales, have added to the fragmentation of the forest. The stands that primarily contributed to fragmentation are the regeneration units. Units that involve thinning treatments did not provide harsh breaks in the canopy, but a reduced crown cover. The aerial view shows the differences from one unit to the other from the point of stand density, but do not necessarily differ from the point of age class.

Based upon aerial photograph interpretation on a landscape basis, the cumulative effects to fragmentation due to previous activities on USFS as well as on privately held ground, including Plum Creek property and small, private landholdings adjacent to Swan River State Forest and the project area, have been an overall increase in the size of younger age-class patches through timber management. Development plans on small, private landowners could result in an increase in fragmentation as forest covertypes are converted to nonforested.

- ***Cumulative Effects of Action Alternatives B, C, and D to Fragmentation***

An overall increase in the patch size of younger age classes and a decrease in the patch size of older age classes would occur where regeneration harvest units are proposed. See the discussion on age classes for acres that would change by alternative.

STAND VIGOR

Issue: The proposed activities may affect forest stand vigor through tree removal.

EXISTING ENVIRONMENT

Stand vigor, a qualitative assessment of stand health in relation to growth potential, is affected by a variety of factors such as stand age and density, insects, diseases, and weather. Insects and diseases are currently very active in the project area, decreasing vigor, reducing growth, causing mortality, removing stands from the old-growth classification, and resulting in lost economic value. Elevated populations of Douglas-fir beetles, fir engravers, mistletoe, mountain pine beetles, white pine blister rust, and various heart rots exist throughout the project area. Indian paint fungus is common in grand fir. The majority of tree species show effects from insect infestations and disease infections, causing value to be lost. Also, tree crowns appear sparse, yellowing, and/or fading in many stands, reflecting poor health and slow growth.

The SLI identifies stand vigor for each stand on Swan River State Forest in 1 of 4 categories. The 4 categories for vigor classification are:

- full,
- good to average,
- just below average to poor, and
- poor.

The majority of the stands in the project area fall in the *good to average* category. However, the majority of those selected for harvesting fall into the *poor* vigor category (*TABLE V-29 – CURRENT HARVEST UNIT VIGOR CLASSIFICATION (PERCENT) BY ACTION ALTERNATIVE).*

ENVIRONMENTAL EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Stand Vigor***

  No immediate change in the proportion of existing stand vigor is expected unless a large disturbance, such as a wildfire, occurs (*TABLE V-29 – CURRENT HARVEST UNIT VIGOR CLASSIFICATION (PERCENT) BY ACTION ALTERNATIVE* and *TABLE V-30 - CURRENT AND POSTHARVEST PROJECT AREA VIGOR).*

Forest succession, driven by the impacts of forest insects and diseases when fires are being suppressed, would continue to reduce stand vigor. As the forest ages and composition becomes more homogenous, vigor is expected to decrease.

- ***Direct and Indirect Effects of Action Alternative B to Stand Vigor***

This alternative proposes regeneration harvests on approximately 1,234 acres using seedtree, seedtree-with-reserves, and shelterwood treatments and variable thinning on approximately 285 acres. This alternative also proposes developing a gravel pit on approximately 22 acres.

Postharvest, *full* vigor would increase on approximately 1,234 acres, *good to average* vigor would increase on approximately 161 acres, *just below average to poor* vigor would decrease on approximately 152 acres, *poor* vigor would decrease on approximately 1,265 acres, and *nonforest-nonwater* would increase on approximately 22 acres.

The proportion of *full* vigor in the project area would increase from 3.5 to 23.4 percent, the proportion of *good to average* vigor would increase from 41.0 to 43.6

TABLE V-29 – CURRENT HARVEST UNIT VIGOR CLASSIFICATION (PERCENT) BY ACTION ALTERNATIVE

VIGOR	ACTION ALTERNATIVE		
	B	C	D
Good to average	0.0	10.3	3.5
Just below average to poor	16.7	27.3	12.9
Poor	83.3	62.4	83.6

percent, the proportion of *just below average to poor* vigor would decrease from 23.4 to 20.9 percent, the proportion of *poor* vigor would decrease from 32.1 to 11.7 percent, and *nonforest-nonwater* will increase to 0.4 percent *(TABLE V-30 - CURRENT AND POSTHARVEST PROJECT AREA VIGOR)*.

- ***Direct and Indirect Effects of Action Alternative C to Stand Vigor***

This alternative proposes regeneration harvests using seedtree, seedtree-with-reserves, shelterwood, and shelterwood-with-reserves treatments on approximately 1,403 acres and variable thinning on approximately 160 acres. This alternative also proposes developing a gravel pit on approximately 22 acres.

Postharvest, *full* vigor would increase on approximately 1,438 acres, *good to average* vigor would decrease on approximately 56 acres, *just below average to poor* vigor would decrease on approximately 189 acres, *poor* vigor would decrease on approximately 1,215 acres, and *nonforest-nonwater* would increase on approximately 22 acres.

The proportion of *full* vigor in the project area would increase from 3.5 to 26.7 percent, the proportion of *good to average* vigor would decrease from 41.0 to 40.1 percent, the proportion of *just below average to poor* vigor would decrease from 23.4 to 20.3 percent, the proportion of *poor* vigor would decrease from 32.1 to 12.5 percent, and *nonforest-nonwater* will increase to 0.4 percent *(TABLE V-30 - CURRENT AND POSTHARVEST PROJECT AREA VIGOR)*.

- ***Direct and Indirect Effects of Action Alternative D to Stand Vigor***

This alternative proposes regeneration harvests using seedtree, seedtree-with-reserves, shelterwood, and shelterwood-with-reserves treatments on approximately 1,051 acres and variable thinning on approximately 135 acres. This alternative also proposes developing a gravel pit on approximately 22 acres.

Postharvest, *full* vigor would increase on approximately 1,085 acres, *good to average* vigor would decrease on approximately 63 acres, *just below average to poor* vigor would decrease on approximately 93

TABLE V-30- CURRENT AND POSTHARVEST PROJECT AREA VIGOR

STAND VIGOR	CURRENT		B		C		D	
			POSTHARVEST					
	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT
Full	215	3.5	1,449	23.4	1,653	26.7	1,300	21.0
Good to average	2,535	41.0	2,696	43.6	2,479	40.1	2,472	40.0
Just below average to poor	1,445	23.4	1,293	20.9	1,256	20.3	1,352	21.9
Poor	1,987	32.1	722	11.7	772	12.5	1,036	16.8
Nonforested /Nonwater	0	0.0	22	0.4	22	0.4	22	0.4
Totals	6,182	100.0	6,182	100.0	6,182	100.0	6,182	100.0

acres, *poor* vigor would decrease on approximately 951 acres, and *nonforest-nonwater* would increase on approximately 22 acres.

The proportion of *full* vigor in the project area would increase from 3.5 to 21.0 percent, the proportion of *good to average* vigor would decrease from 41.0 to 40.0 percent, the proportion of *just below average to poor* vigor would decrease from 23.4 to 21.9 percent, the proportion of *poor* vigor would decrease from 32.1 to 16.8 percent, and *nonforest-nonwater* will increase to 0.4 percent *(TABLE V-30 - CURRENT AND POSTHARVEST PROJECT AREA VIGOR)*.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Stand Vigor***

  Current stand vigor would remain the same across the forest. Over time, stand vigor would be expected to decrease in the absence of disturbance or management. Occurrences of mortality of trees or groups of trees would reduce the stand vigor in localized areas. Limited salvaging may increase the stand vigor in localized areas. Large reductions in stand vigor would occur if a large fire came through the area and salvage harvesting and regeneration or replanting attempts did not follow.

- ***Cumulative Effects of Action Alternatives B, C, and D to Stand Vigor***

  Cumulative effects would result in an increase in vigor within areas where harvesting has occurred, and a decrease in vigor within areas where harvesting has not occurred and the trees no longer perform to their highest potential, become susceptible to insects and diseases, etc.

  Based on aerial photograph interpretation on a landscape basis, the cumulative effects to stand vigor due to previous activities on USFS as well as privately held ground, which includes Plum Creek property and small, private land holdings adjacent to Swan River State Forest and the project area, have typically been similar to those described for Swan River State Forest, above. Vigor typically increases as stands are harvested and regenerate postharvest; vigor typically decreases as a stand ages and remains in an unmanaged state. Exact stand vigor assessments were not possible due to lack of field reconnaissance on non-DNRC-managed ground. Development plans on small, private lands could result in a slight decrease in overall stand vigor as land is converted to nonforested.

STAND STRUCTURE

Issue: The proposed activities may affect forest stand structure through tree removal.

EXISTING ENVIRONMENT

Stand structure indicates a characteristic of stand development and how the stand would continue to develop. The disturbance regime or most recent disturbance event can also be reflected.

Single-storied stands are most often associated with stand-replacement events such as severe fires or clearcut harvesting, and are more common in younger-aged stands where understory reinitiation has not begun. Over time, these single-storied stands generally develop into multistoried stands or other more complex structures through the process of forest succession.

Two-storied stands are often associated with areas of less severe fires and usually have trees that are more fire-resistant, such as western larch or Douglas-fir, left in the overstory. Also, two-storied stands frequently develop where an understory of shade-tolerant species grows under an even-aged overstory, such as subalpine fir growing under a canopy of lodgepole pine. Regeneration harvests that retain approximately 10 percent crown cover in the overstory and have a seedling/sapling understory are also classified as two-storied stands.

The multistoried condition arises when a stand has progressed through time and succession to the point that shade-tolerant species are advancing into the overstory. Often a long interval of time occurs between major disturbances. Many of these stands originated as single-storied stands.

Heterogeneous stands occur when various combinations of single-storied, two-storied, and multistoried structures exist throughout a stand.

Classic uneven-aged stands are associated with conditions where there are no distinct canopy levels because the trees vary in size from seedlings to sawtimber.

Seedtree and seedtree-with-reserves harvest treatments would shift stands from their current class structure to a single-storied class. Shelterwood treatments would initially move stands from their current structure to a two-storied class, which would again shift to a multistoried stand upon the establishment of seedlings if the overstory was not removed through later harvesting activities. Variable thinning harvest treatments would move stands from the current structure towards a multistoried stand.

TABLE V - 31 – CURRENT AND POSTHARVEST STAND STRUCTURE (PERCENT) IN THE PROJECT AREA compares the current proportion of stands and the postharvest results by alternative in single-storied, two-storied, and multistoried stands within the project area.

ENVIRONMENTAL EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Stand Structure***

  No immediate change in the proportion of existing stand structure is expected unless a large disturbance, such as a wildfire occurs (*TABLE V-31 – CURRENT AND POSTHARVEST UNIT STAND*

TABLE V-31 – CURRENT AND POSTHARVEST UNIT STAND STRUCTURE (PERCENT) IN THE PROJECT AREA

STAND STRUCTURE	CURRENT AMOUNTS	POSTHARVEST ACTION ALTERNATIVE		
		B	C	D
Single-storied	20.4	38.6	39.9	34.0
Two-storied	21.7	18.9	21.8	23.1
Multi-storied	26.0	22.0	25.9	20.9
Heterogeneous	5.2	5.2	4.9	5.2
Classic uneven-aged	26.7	15.3	7.5	16.8
Total acres[1]	6,182	6,160	6,160	6,160

[1] *Acreage removed to account for nonforested ground, including creation of a gravel pit*

STRUCTURE (PERCENT) IN THE PROJECT AREA) .

Forest succession, driven by the impacts of insects and diseases when fires are being suppressed, would reduce the variability of stand structure. As the forest ages and composition become more homogenous, so would the stand type.

- ***Direct and Indirect Effects of Action Alternative B to Stand Structure***

This alternative proposes regeneration harvesting on approximately 1,234 acres using seedtree, seedtree-with-reserves, and shelterwood treatments and variable thinning on approximately 285 acres. This alternative also proposes developing a gravel pit on approximately 22 acres.

The single-storied stand structure would increase approximately 1,117 acres, the two-storied stand structure would decrease approximately 177 acres, the multistoried stand structure would decrease approximately 242 acres, and the classic uneven-aged acres would decrease approximately 709 acres. Approximately 22 acres would be incrementally removed from the stand structure category through the creation of the gravel pit proposed in Section 24, T23N, R18W.

The proportion of single-storied stand structure in the project area would increase from 20.4 percent currently to 38.6 percent, the proportion of two-storied stand structure would decrease from 21.7 to 18.9 percent, the proportion of multistoried stand structure would decrease from 26.0 to 22.0 percent, and the proportion of classic uneven-aged stand structure would decrease from 26.7 to 15.3 percent (*TABLE V-31 – CURRENT AND POSTHARVEST UNIT STAND STRUCTURE (PERCENT) IN THE PROJECT AREA*).

- ***Direct and Indirect Effects of Action Alternative C to Stand Structure***

This alternative proposes regeneration harvests using seedtree, seedtree-with-reserves, shelterwood, and shelterwood-with-reserves treatments on approximately 1,403 acres and variable thinning on approximately 160 acres. This alternative also proposes developing a gravel pit on approximately 22 acres.

The single-storied stand structure would increase approximately 1,197 acres, the two-storied stand structure would increase approximately 2 acres, the multistoried stand structure would decrease approximately 12 acres, the heterogeneous stand structure would decrease approximately 19 acres, and the classic uneven-aged acres would decrease approximately 1,189 acres. Approximately 22 acres would be incrementally removed from the stand structure category through the creation of the gravel pit proposed in Section 24, T23N, R18W.

The proportion of single-storied stand structure in the project area would increase from 20.4 percent currently to 39.9 percent, the proportion of two-storied stand structure would slightly increase from 21.7 percent to 21.8 percent, the proportion of multistoried stand structure would slightly decrease from 26.0 to 25.9 percent, the proportion of heterogeneous stand structure would decrease from 5.2 to 4.9 percent, and the proportion of classic uneven-aged stand structure would decrease from 26.7 to 7.5 percent (*TABLE V-31 – CURRENT AND*

POSTHARVEST UNIT STAND STRUCTURE (PERCENT) IN THE PROJECT AREA).

- ***Direct and Indirect Effects of Action Alternative D to Stand Structure***

This alternative proposes regeneration harvests using seedtree, seedtree-with-reserves, shelterwood, and shelterwood-with-reserves treatments on approximately 1,051 acres and variable thinning on approximately 135 acres. This alternative also proposes developing a gravel pit on approximately 22 acres.

The single-storied stand structure would increase approximately 833 acres, the two-storied stand structure would increase approximately 82 acres, the multistoried stand structure would decrease approximately 320 acres, and the classic uneven-aged acres would decrease approximately 616 acres. Approximately 22 acres would be incrementally removed from the stand structure category through the creation of the gravel pit proposed in Section 24, T23N, R18W.

The proportion of single-storied stand structure in the project area would increase from 20.4 percent currently to 34.0 percent, the proportion of two-storied stand structure would increase from 21.7 to 23.1 percent, the proportion of multistoried stand structure would decrease from 26.0 to 20.9 percent, and the proportion of classic uneven-aged stand structure would decrease from 26.7 to 16.8 percent (*TABLE V - 31 – CURRENT AND POSTHARVEST STAND STRUCTURE (PERCENT) IN THE PROJECT AREA*).

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Stand Structure***

The cumulative effects to stand structure distributions due to previous activities on Swan River State Forest are represented in descriptions of the current condition. Generally speaking, those effects have been to reduce the acres in multistoried or classic uneven-aged stand structures while increasing the acres in the single-storied stand structure through even-aged management.

However, as a whole, the forest contains a mosaic of structures that include single-storied, two-storied, and multistoried conditions. The structure changes through harvesting, which emulates fire disturbance that historically occurred in Swan River State Forest. Fire disturbance emulations range from stand replacing to mixed severity to light underburns.

Seedtree and seedtree-with-reserves harvest prescriptions emulate a stand-replacement fire because the largest share of trees would be harvested and would result in a single-storied stand structure.

Shelterwood and shelterwood-with-reserves harvest prescriptions would emulate a mixed-severity or moderate-intensity fire and would result in a two-storied stand structure.

A variable-thinning harvest prescription emulates the effects of low-intensity fires with flare-ups that are common in the mixed-severity fire regime. Harvesting would retain at least 40-percent canopy coverage. The species retained would consist of all tree age and size classes variably spaced to move the forest towards desired future conditions for the area while promoting horizontal and vertical diversity, or a multistoried structure, within the stand. Individual trees remaining in the stand would have more light and nutrients for continued growth and vigor.

Gravel pit development in slated areas would remove acreage out of a forested status and into a nonforested status. No stand structure other than incidental seedlings would be within the pit area.

Barring natural disturbance, over time, untreated stands would gradually shift toward heterogeneous, multistoried, or classic uneven-aged stand structures. Treated stands would also gradually shift toward those stand structures through time.

Based on aerial photograph interpretation on a landscape basis, the cumulative effects to stand structure distributions due to previous activities on USFS as well as on privately held ground, which includes Plum Creek property and small, private landholdings adjacent to Swan River State Forest and the project area, have been variable. Actively managed areas tend to resemble a single-storied stand structure of a single age class, or rather, a stand very homogeneous in appearance. Areas that have not been actively managed can appear single-storied to multistoried due to variances in stand conditions and age classes. Exact stand structure assessments were not possible due to lack of field reconnaissance on non-DNRC-managed ground. Development plans on small, private landholdings could result in a decrease in total forested stand structure as ground is converted to nonforested.

- ***Cumulative Effects of Action Alternatives B, C, and D to Stand Structure***

  The cumulative effects of the action alternatives would be similar to those seen in the no-action alternative; however, across areas where management would occur, the result would be a greater increase in the single-storied stand structure and to a certain extent, the multistoried stand structure.

CROWN COVER

Issue: The proposed activities may affect forest crown cover through tree removal.

EXISTING ENVIRONMENT

Crown cover, an estimate of the ratio between tree crown area and ground surface area, is usually expressed in terms of percent and is another measure of stand stocking and density. Categories used to describe crown cover include well stocked (over 70 percent), medium stocked (40 to 69 percent), poorly stocked (less than 39 percent), nonstocked, and nonforested.

The SLI database has a rating for overall crown cover and a rating for sawtimber crown cover in the stand. In terms of overall crown cover within the project area, 59.6 percent of stands are well stocked, 16.9 percent show medium stocking, 20.6 percent are poorly stocked, 1.0 percent is nonstocked, and 1.9 percent are nonforested. Sawtimber stocking within the project area shows that 23.9 percent of stands are well stocked, while 19.4 percent of stands have medium sawtimber stocking. The poorly- stocked sawtimber category consists of 27.5 percent of the project area; the associated stands are typically in poor health or have high quantities of rock and/or brush. Timber in these stands is generally not of good merchantable quality, but in the instance of poor stand health, steps may be taken to address the issue. The nonstocked sawtimber category consists of 27.2 percent of the project area and the associated stands are typically those that have had regeneration harvest treatments in the past. The nonforested category is 1.9 percent.

ENVIRONMENTAL EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Crown Cover***

  No-Action Alternative A would not change the crown cover in the short term. Over time, individuals and groups of trees would be removed from the canopy by insects, diseases, windthrow, or fires and would result in variable changes to crown cover as canopy gaps are created and gradually filled. Patches of variable size currently exist where the Douglas-fir bark beetles have killed Douglas-fir and white pine blister rust has killed western white pine.

  Overall, crown cover and stocking would likely increase over time in the absence of disturbances. Were large fires to occur, overall crown cover would be reduced. Ongoing insect and disease issues would reduce crown cover and sawtimber stocking in some areas prior to understory reinitiation.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Crown Cover***

  The reduction in crown cover subsequent to harvest treatments would vary by action alternative and its silvicultural prescription. In general, reduced crown cover affects stand growth and development in various ways. First, competition among the crowns of overstory trees is reduced, allowing accelerated volume growth and increased seed production. Second, competition for water and nutrients is reduced, thus allowing trees to be more resistant to both drought and bark beetle attacks. Third, a more diverse and vigorous understory is able to establish. Finally, sunlight is allowed to reach the forest floor, which, along with seedbed preparation, is of particular importance to the successful regeneration of seral species such as western larch and western white pine. For this analysis, the residual canopy cover includes both the overstory and understory tree canopies remaining after harvesting, including both merchantable and submerchantable trees.

  In areas with seedtree or seedtree-with-reserves harvests, the final crown coverage would be an average of 15 percent. In areas with shelterwood or shelterwood-with-reserves harvesting, the final canopy coverage would be an average of 22 percent. In areas with variable-thinning harvests, the final canopy coverage would be a minimum of 40 percent.

  Under Action Alternative B, the project area would have approximately 36.0 percent well-stocked stands, approximately 20.1 percent medium-stocked stands, approximately 40.6 percent poorly-stocked stands, approximately 1.0 percent nonstocked stands, and approximately 2.3 percent nonforested stands (see *TABLE V-32 - PERCENT OF PROJECT AREA*

CURRENT AND POSTHARVEST CROWN COVER BY ALTERNATIVE).

Under Action Alternative C, the project area would have approximately 35.2 percent well-stocked stands, approximately 18.2 percent medium-stocked stands, approximately 43.3 percent poorly-stocked stands, approximately 1.0 percent nonstocked stands, and approximately 2.3 percent nonforested stands (see *TABLE V-32 - PERCENT OF PROJECT AREA CURRENT AND POSTHARVEST CROWN COVER BY ALTERNATIVE*).

Under Action Alternative D, the project area would have approximately 41.0 percent well-stocked stands, approximately 18.1 percent medium-stocked stands, approximately 37.6 percent poorly-stocked stands, approximately 1.0 percent nonstocked stands, and approximately 2.3 percent nonforested stands (see *TABLE V-32 - PERCENT OF PROJECT AREA CURRENT AND POSTHARVEST CROWN COVER BY ALTERNATIVE*).

Riparian stands associated with perennial streams, namely Whitetail, Woodward, and South Woodward creeks, would not be treated or experience reduced crown coverage. A 100-foot buffer would be retained where activity occurs on one side of the stream and sawtimber stocking is present on the other side of the stream. A 300-foot buffer, or 150 feet on each side of the stream, would be retained where harvesting activities occur on both sides of the stream.

All other streams within or adjacent to a harvest unit would have buffers 100 or 200 feet wide (50 or 100 feet each side of the stream) unless connectivity warrants a greater width.

Crown cover would increase over time as regeneration replaces the harvested units that received seedtree, seedtree-with-reserves, shelterwood, shelterwood-with-reserves, and variable thinning treatments. Fifteen to 20 years and 5 to 10 years would be needed to develop 70- to 100-percent crown cover within the regeneration and variable thinning harvest units, respectively.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Crown Cover***

Current crown cover would remain the same across the forest. Over time, crown cover would be expected to increase in

TABLE V-32 - PERCENT OF PROJECT AREA CURRENT AND POSTHARVEST CROWN COVER BY ALTERNATIVE

CROWN COVER	CURRENT	POSTHARVEST		
		B	C	D
Well-stocked	59.6	36.0	35.2	41.0
Medium-stocked	16.9	20.1	18.2	18.1
Poorly-stocked	20.6	40.6	43.3	37.6
Nonstocked	1.0	1.0	1.0	1.0
Nonforested	1.9	2.3	2.3	2.3

the absence of disturbance. Mortality of trees or groups of trees would reduce the canopy coverage in localized areas. Large reductions in crown cover would occur if a large fire came through the area.

- ***Cumulative Effects of Action Alternatives B, C, and D to Crown Cover***

  Overall reductions of crown cover in well-stocked stands would be dispersed across the landscape. Representation of medium-stocked stands would increase following harvesting, as would poorly-stocked stands. As stands regenerate, crown cover would increase. Based on aerial photograph interpretation on a landscape basis, the cumulative effects to crown cover due to previous activities on USFS as well as privately-held ground, including Plum Creek property and small, private landholdings adjacent to Swan River State Forest and the project area, have been similar to those described for Swan River State Forest, above. These properties are similar in that their stocking level typically increases as stands regenerate postharvest and all entities have created a mosaic of crown cover stocking levels on the landscape. Exact crown cover assessments were not possible due to lack of field reconnaissance on non-DNRC-managed ground. Development plans on small, private lands could result in a decrease in crown cover as land is converted to nonforested.

INSECTS AND DISEASES

Issue: The proposed activities may affect forest insect and disease levels through tree removal (both suppressed/stressed and infested/infected).

EXISTING ENVIRONMENT

Planning for the long-term management of forest insects and diseases is an important part of designing project-level timber sales. Various forest species compositions and structures are more vulnerable to certain insects, diseases, windthrow, and wildfire than others (*Byler and Hagle 2000*). Identifying stands with the most vulnerable compositions and structures and developing suitable management plans can help alleviate future problems that may prevent achievement of long-term objectives for forest management.

Insect and disease activities are recorded and mapped annually from aerial flight surveys. New occurrences and the progression of existing pockets, along with approximate acreages and locations, are collected. Field surveys identify areas with insect and disease activities for timber-harvesting opportunities. Maps of several successive years of flight surveys are available at the Swan River State Forest office.

The major forest insects and diseases currently affecting forest productivity include:

Diseases

Armillaria root disease (*Armillaria ostoyae*)
Larch dwarf mistletoe (*Arceuthobium laricis*)
White pine blister rust (*Cronartium ribicola*)
Indian paint fungus (*Echinodontium tinctorium*)
Red-brown butt rot (*Phaeolus schweinitzii*)
Red ring rot (*Phellinus pini*)

Insects

Douglas-fir bark beetle (*Dendroctonus pseudotsugae*)
Fir engraver (*Scolytus ventralis*)

Mountain pine beetle (*Dendroctonus ponderosae*)

- **Armillaria Root Disease**

Armillaria root disease, caused by the fungus *Armillaria ostoyae,* is a common pathogen of conifers in western North America. Stands impacted by Armillaria root disease occur throughout the project area.

Armillaria ostoyae is spread mainly via root contacts, but also through a short-distance growth of rhizomorphs through soil (*Redfern and Filip 1991*). The fungus colonizes the root collar, kills the cambium, and eventually girdles the tree, which causes mortality. Viable *Armillaria ostoyae* inoculum can persist in below-ground portions of stumps and large roots for decades (*Roth et al. 1980*). Conifers exhibit variations both in response to infection by *Armillaria ostoyae* (*Robinson and Morrison 2001*) and susceptibility to mortality (*Hadfield et al. 1986*). Species susceptibility and damage ratings for Armillaria root disease in western Montana are:

- *severe damage*: Douglas-fir, grand fir, subalpine fir
- *moderate damage*: ponderosa pine, lodgepole pine, western white pine
- *infrequent damage*: western larch and western red cedar

Western larch, in particular, shows increasing resistance to *Armillaria* beyond age 15 (*Morrison et al. 1991*) and is colonized by root lesions less frequently than comparably aged Douglas-fir (*Robinson and Morrison 2001*). All conifers should, however, be considered equally susceptible to *Armillaria ostoyae* before ages 15 to 20 (*Hadfield et al. 1986; Morrison et al. 1991*).

Silvicultural approaches that emphasize seral species are recommended even for stands with low levels of Armillaria root disease (*Filip and Goheen 1984; Morrison and Mallett 1996*). Selective cutting in such stands is the least favorable option as it would likely result in an increased inoculum load in the form of *Armillaria ostoyae*-colonized root systems dispersed among the remaining crop trees (*Morrison et al. 2001; Morrison and Mallett 1996*). In mixed-species stands composed of shade-intolerant, early-seral species and shade-tolerant, late-successional species, the seral species should be favored during intermediate stand entries in order to limit the root-to-root pathways between more readily damaged species. In stands where root disease is a factor, natural regeneration should be utilized if possible because planted trees seldom show the resistance displayed by naturally regenerated trees (*Morrison et al. 2000; Rizzo et al. 1995*).

- **Western Larch Dwarf Mistletoe**

Western larch dwarf mistletoe, caused by *Arceuthobium laricis*, is considered the most important disease of western larch in the Inland West (*Beatty et al. 1997*). Dwarf mistletoes are parasitic plants that obtain moisture and nutrients from their hosts, resulting in a reduction in tree vigor, growth, and seed production. Infections greatly decrease the growth of western larch; 10-year basal-area growth of trees in western Montana classed as lightly, moderately, and heavily infected was decreased 30, 42, and 65 percent, respectively, compared to that of an uninfected western larch (*Pierce 1960*).

The life cycle of dwarf mistletoe is generally 4 to 6 years in length, depending on the species. Dwarf mistletoes spread when seeds from the female mistletoe plants are forcibly dispersed, often for tens of feet, in late summer and fall; seeds that land on susceptible hosts germinate the following spring and infect the host tissues. Infections on western larch eventually cause branches to form dense clumps of twigs and branches known as 'witches brooms'. In western larch these brooms are brittle and prone to break off under snow load, thus leading to gradual, top-down decline of the tree as more and more branches are lost. In addition, infection by dwarf mistletoe increases moisture stress in its host, more so when a drought is in progress, adding to the likelihood of top-down decline and attack by wood borers (*Gibson 2004*).

The incidence and severity of western larch dwarf mistletoe appears to be highly variable across the project area. This variation most likely reflects a complex history of mixed-severity and stand-replacing fires in these forests. Such fires would variously leave both mistletoe-infected and noninfected trees to provide seed for the next generation. Depending on the spatial distribution of infected, seed-bearing trees following fires, western larch regeneration might remain free of infection, have a substantial lag-time prior to infection, or become infected early in development. The earlier a tree becomes infected by dwarf mistletoe, the greater the impacts.

Due to the seeding habit of dwarf mistletoes, spread and intensification are at their worst when an infected overstory exists over the regeneration of the same tree species. Seedtree or shelterwood treatments can still be carried out in stands that have dwarf mistletoe infections in the overstory, but tree selection in such instances needs to discriminate against the most heavily dwarf mistletoe-infected western larch and leave as many noninfected or lightly-infected trees as possible (*Beatty et al. 1997*).

To minimize dwarf mistletoe infection in western larch regeneration, the infected overstory trees should be removed or killed once western larch regeneration is established and before regeneration reaches the age of 7 years old or 3.3 feet in height (*Mathiasen 1998*).

- **White Pine Blister Rust**

Western white pine has declined as a component of the mixed-conifer forest where it occurred historically on Swan River State Forest. The primary cause is white pine blister rust, a disease caused by the nonnative fungus *Cronartium ribicola*, which can infect and kill western white pine of all ages and sizes. Dominant or codominant western white pine infected with blister rust are often top-killed since the fungus first infects needles before growing down the infected branch and, eventually, girdling the bole. The portion of crown above such a bole infection will die once the stem is girdled.

Some western white pine remain on Swan River State Forest because either they possess natural genetic resistance to the rust or have not been infected. Retention of various numbers of mature, seed-bearing western white pine is encouraged in order to maintain genetic diversity of the species and promote natural regeneration where possible (*Schwandt and Zack 1996*). Once mature western white pine are top-killed by rust, however, their seed-producing capacity is often very limited or eliminated, and such trees can then be considered for salvage or retention as snags (*Schwandt and Zack 1996*).

Western white pine are susceptible to attack by the mountain pine beetle (*Dendroctonus ponderosae*), even when existing as relatively isolated individuals or small groups in mixed-conifer stands; damage from this bark beetle is chronic in the Inland Empire.

Management and restoration recommendations for western white pine emphasize planting rust-resistant western white pine seedlings and maintaining western white pine genetic diversity (*Fins et al. 2201*).

The monitoring of rust levels should be performed at various times in the life of a stand; bole pruning to reduce the chances of blister rust infections may be required if rust levels are high when the stand is young.

- **Indian Paint Fungus**

Indian paint fungus, so called because Native Americans used the brick-red interior of the fruiting body in making pigment, is a true heartrot that very commonly infects true firs and hemlocks. This fungus is the predominant cause of heartrot and volume losses in these species in western North America (*Hansen and Lewis 1997*). True heartrots, generally confined to the heartwood of trees, consistently produce fruiting bodies or conks on the stems of living trees and do not rely on mechanical wounding as their principal infection court (*Ethridge and Hunt 1978*). Large diameter grand fir with decay caused by Indian paint fungus are important habitat, both while standing and down, for various species of cavity-nesting birds and mammals (*Bull et al. 1997*).

Trees are infected with *Echinodontium tinctorium* spores via very small branchlet stubs. The spores germinate before the infection goes dormant after being overgrown by the tree, and can then stay dormant for decades (*Maloy 1991*). Heaviest infections tend to occur in advanced regeneration growing under an infected overstory. Growth of the fungus is reactivated when the tree is wounded either naturally or mechanically, develops frost cracks, or is otherwise physiologically altered. The fungus causes extensive decay of the heartwood and, over time, these trees become more susceptible to stem collapse. A rule of thumb is that one conk on the stem of a tree indicates approximately 16 feet of extensive heartwood decay in either direction, while several conks on the stem of a tree indicate that the tree is a cull. In the project area, Indian paint fungus is well distributed on grand and subalpine firs. Stand exams and reconnaissance surveys reveal a 30- to 40-percent infection rate. To reduce losses from this pathogen, management recommendations include (*Filip et al. 1983*):

- keeping rotations of susceptible species under 150 years unless the amount of infection is light;
- thinning early;
- selecting the most vigorous nonwounded trees for residuals; and
- minimizing wounding of susceptible hosts when thinning, prescribed burning, or performing silvicultural treatments.

➢ **Red-Brown Butt Rot**

Red-brown butt rot is caused by the root-infecting pathogen *Phaeolus schweinitzii*. Any conifer can be a host, but infection is considered of primary importance in Douglas-fir. Instead of affecting trees in groups as do root diseases such as Armillaria root disease, red-brown butt rot tends to affect trees on an individual basis (*Hansen and Lewis 1997*). The fungus can, however, cross from tree-to-tree at root grafts and contacts. Most damage occurs in stands more than 80 years of age. The pathogen infects via small roots and causes decay in the interior of the roots. This decay extends into the butt log an average of eight feet, making such trees susceptible to stem collapse and windthrow. Since most are green when windthrown, the trees provide prime habitat for Douglas-fir and other bark beetles. Management options are limited. Rotations can be shortened to about 90 years in Douglas-fir to minimize loss due to decay, and less-affected host species can be emphasized over Douglas-fir.

➢ **Douglas-Fir Bark Beetle**

The Douglas-fir bark beetle has been active in recent years across Swan River State Forest. The project area has an elevated incidence of the Douglas-fir bark beetle in areas proposed for harvesting. In general, stands that are at highest risk to attack by the Douglas-fir bark beetle are those with:

- basal areas greater than 250 square feet per acre;
- an average stand age greater than 120 years;
- an average dbh greater than 14 inches; and
- a stand composition greater than 50 percent Douglas-fir (*USDA Forest Service 1999)*.

Douglas-fir in most of the proposed harvest areas are at high risk of Douglas-fir bark beetle attack due to age, size, and stocking. Low, or endemic, populations of Douglas-fir bark beetles tend to exist in fresh blowdown, fire-killed trees, or live trees within and around pockets of root disease (*Livingston 1999; Schmitz and Gibson 1996*). Management of the Douglas-fir bark beetle should concentrate on the removal of windthrown Douglas-fir and the salvage of newly attacked trees before adult beetles can emerge (*Livingston 1999; Schmitz and Gibson 1996*). Valuable Douglas-fir (e.g. those in and around campgrounds) considered to be at high risk can be protected by use of the Douglas-fir bark beetle anti-aggregant pheromone 3-methylcyclohex-2-en-1-one (*Ross et al. 2001*).

Numerous pockets of infestations were located within the analysis area in 2003. Each spring, aerial surveys and light field reconnaissances by DNRC foresters were completed to determine the extent of infestations (see *FIGURE V-12 - INSECT*

ACTIVITY 2003 THROUGH 2007 IN THE VICINITY OF THE PROJECT AREA, ALL ALTERNATIVES). Beetles were estimated to have caused heavy Douglas-fir mortality on approximately 1,000 acres. The Swan River State Forest timber permit program allowed for the salvage harvesting of approximately 1 MMbf of sawlogs in 2005, 400 Mbf in 2006, and 500 Mbf in 2007.

- **Fir Engraver**

The fir engraver, *Scolytus ventralis*, has recently killed many grand and subalpine firs in the Swan Valley. This bark beetle is wide-ranging across the west, attacking primarily grand fir (*Ferrell 1986*). Endemic populations of fir engraver beetles are closely associated with root disease or other factors that stress its hosts; they rarely make successful attacks on vigorous grand fir (*Goheen and Hansen 1993*). However, when grand fir and other preferred hosts become stressed during periods of drought, the fir engraver can begin attacking otherwise healthy trees across the landscape, and the association with root disease becomes less distinct (*Goheen and Hansen 1993*).

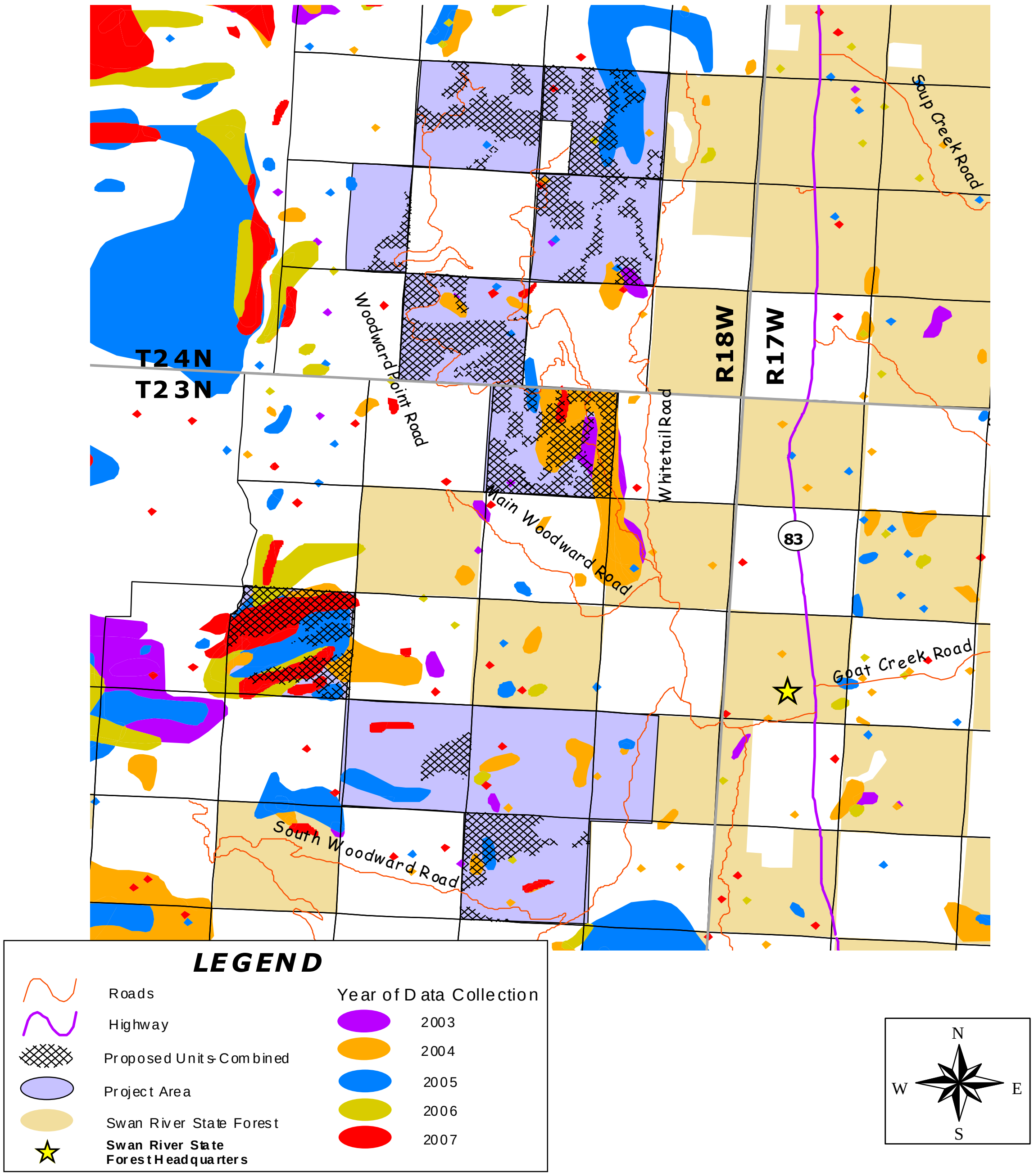
Silvicultural practices that promote the vigor of grand fir stands (thinning, for example) would also reduce the chances of extensive damage during periods of drought (*Ferrell 1986*). Management practices aimed at reducing the impact of root diseases would also help lessen the long-term impacts of the fir engraver. Such practices include the promotion of species less susceptible to root disease, such as western larch, western white pine, and ponderosa pine, in areas with extensive root disease.

- **Mountain pine beetle**

Mountain pine beetle (*Dendroctonus ponderosae*) is a native North American bark beetle with four major hosts, one being western white pine (*Amman et al. 1989*). Historically, when extensive stands of mature western white pine still existed, mountain pine beetle outbreaks could kill a large majority of trees just as the mountain pine beetle does today in extensive stands of lodgepole pine. The occurrence of pitch tubes along the bole is one way to determine if attacks by mountain pine beetles have occurred. Pitch tubes on successfully attacked trees are generally very numerous, one-fourth to one-half inch in diameter and consist of cream- to dark red-colored masses of resin mixed with frass. Pitch tubes on unsuccessfully attacked trees are widely scattered over the bole of the tree, three-quarters to one inch in diameter, and mostly cream colored. Confirmation of a mountain pine beetle attack can be done by looking for the characteristic gallery patterns on the inner side of the bark. Bark beetles attacking western white pine also introduce aggressive blue stain fungi that grow into the sapwood and contribute to the death of the tree.

Mountain pine beetles produce one generation per year, though sometimes pupae or brood adults will last longer at higher elevations. The beetles overwinter mostly as larvae within the egg galleries, then maturate and emerge as adults to attack more trees from June through August. The foliage of trees that have been successfully attacked during

FIGURE V-12 - INSECT ACTIVITY 2003 THROUGH 2007 IN THE VICINITY OF THE PROJECT AREA, ALL ALTERNATIVES



the current year can change color anywhere from a few months to a year later. Therefore, mountain pine beetle brood trees that have been attacked the previous summer and removed during late winter or spring salvage operations may still have green foliage.

Numerous pockets of infestations were located within the analysis area in 2005. Each spring, aerial surveys, as well as light field reconnaissance by DNRC foresters, were completed to determine the extent of the infestations (see *Figure V-12 - INSECT ACTIVITY 2003 THROUGH 2007 IN THE VICINITY OF THE PROJECT AREA, ALL ALTERNATIVES*). The beetle was estimated to have caused heavy lodgepole pine mortality on approximately 1,300 acres. Due to the lack of road infrastructure, salvage harvesting has not occurred in these areas.

ENVIRONMENTAL EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Insects and Diseases***

Sawlog volume would continue to be lost from the project area due to insect and disease effects, especially from Douglas-fir bark beetles, Armillaria root disease, mountain pine beetles, and Indian paint fungus in inaccessible stands with large trees. Salvage logging would continue where stands are accessible without building roads.

If this alternative were implemented, seral and other shade-intolerant species, such as western larch and Douglas-fir, would continue to be lost from insect infestations and disease infections. The spread of the fir engraver would continue, causing mortality in grand and subalpine firs.

School trusts may lose long-term revenue due to:

- increasing mortality rates and sawlog defect that are caused by the ongoing presence of a variety of the aforementioned pathogens;
- reduced growth rates as old-growth stands continue to age and defects increase; and
- the nonregeneration of high-valued species such as western larch and western white pine.

- ***Direct Effects of Action Alternatives B, C, and D to Insects and Diseases***

Harvest treatments would target those species or individuals affected by insects and diseases, as well as the salvage of recently killed trees. Douglas-fir currently or recently infested by the Douglas-fir bark beetle, lodgepole pine currently or recently infested by the mountain pine beetle, and grand fir currently or recently infested by the fir engraver would be removed when merchantable value exists. Western larch with the most severe infections of dwarf mistletoe would be harvested. Grand fir, western hemlock, and subalpine fir would be removed if infected with Indian paint fungus. Western white pine currently heavily infected or recently killed by white pine blister rust would be removed when merchantable value exists. Trees within armillaria root rot pockets would be removed, particularly if conversion to early-seral species is possible. By removing green infected trees, the continued spread of the various insects and diseases would be hampered.

Seedtrees, primarily western larch, would be left scattered throughout the harvest units to provide a seed source for natural regeneration.

Insect and disease problems would be reduced following implementation of any action alternative. Action Alternative B does the most to control rates of spread, economic value loss, and volume loss within the project area. The other action alternatives in order of decreasing efficacy in treating insect and disease activities would be C and D.

- ***Direct Effects of Action Alternative B to Insects and Diseases***

Units proposed for harvesting under this alternative have been rated as having moderate-to-high or high levels of insect and disease activities. Treatments are focused on those stands with the greatest amounts of mortality and loss of economic value. Treatments would remove merchantable dead timber, green timber affected by insects and diseases, those with reduced growth rates due to age, individual trees considered at risk of infection, and the less desirable shade-tolerant species that are more susceptible to insect and disease problems.

The majority of the units would be treated with regeneration harvests, but some variable thinning would be applied. Regenerating species would be shade-intolerant species, such as western larch, that are more resistant to many of the infecting agents currently present. This alternative treats the most acres (1,519) with moderate-to-high and high levels of insect and disease problems in the project area.

- ***Direct Effects of Action Alternative C to Insects and Diseases***

The stands selected for this alternative are concentrated to the north portion of the project area and have insect and disease activities occurring at all levels, from low-to-moderate to high levels. Emphasis would be placed on trees (groups or individuals) that are affected by insects or diseases, are at risk of infection, or, if dead, contain merchantable material. Emphasis would also be placed on site-intensive management of lower risk stands. In units utilizing a regeneration harvest, seedtrees would remain scattered throughout to provide a seed source; these seedtrees would primarily be shade-intolerant species, such as western larch, that have a higher tolerance to insects and diseases. This alternative treats 1,186 acres with moderate-to-high and high levels of insect and disease problems in the project area.

- ***Direct Effects of Action Alternative D to Insects and Diseases***

The stands selected for this alternative have insect and disease activities occurring at all levels, from low-to-moderate to high levels. An objective for this alternative was to limit the amount of old-growth stands that would be harvested. In doing so, approximately 665 acres of the stands most affected by insect and disease activities, slated for treatment with Action Alternative B or both Action Alternatives B and C, would be avoided. Areas of known beetle populations and other diseases would be left untreated, which would allow the continued spread of existing insect and disease problems.

In the treated units, emphasis would be placed on the removal of trees affected by insects and diseases, those considered at high risk, and shade-tolerant species that do not meet the desired future conditions. The avoidance of many stands with known insect and disease problems results in this alternative having the least effect on reducing insect and disease problems. This alternative treats 1,057 acres with moderate-to-high and high levels of insect and disease problems in the project area.

- ***Indirect Effects of Action Alternatives B, C, and D to Insects and Diseases***

Where shelterwood and variable-thin treatments are applied, an indirect effect would be increased vigor and growth rates of the remaining trees due to the availability of light, nutrients, and moisture. Following treatment, the species composition would be more resilient to damage by forest diseases and insects.

Rust-resistant western white pine, western larch, and, in some cases, ponderosa pine would be planted in units utilizing seedtree harvest treatments. The western white pine seedlings would increase a declining component on Swan River State Forest. The planting of western larch would help reduce the likelihood of future insect and disease problems due to its lower susceptibility to many of the problems being addressed.

Under Action Alternative B, the newly established stands would be healthier and the overstory would not be laden with insect and disease activities that would infect/infest the seedlings. This alternative would also treat the most acres with moderate-to-high and high insect and disease problems, which, in turn, would lead to healthier forest stands in the future.

Action Alternative C also proposes harvesting insect-infested and disease-infected stands concentrated in the north portion of the project area. This alternative would not treat as many acres with moderate-to-high or high insect and disease problems as Action Alternative B, but would have similar effects on the acres that were treated. Overall, this alternative would do less than Action Alternative B to address the insect and disease problems prevalent in the project area.

Action Alternative D would do the least to address insect and disease problems in the project area. Treatments in stands currently affected by insect and disease problems would provide benefits to the newly developed stands. Treatments in stands that do not currently have insect or disease problems would protect and potentially enhance resistance to future insect and disease activities. However, the avoidance of known insect and disease hotspots would provide a dissemination source, which would increase the future spread of insect and disease problems when compared to the other alternatives.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Insects and Diseases***

No harvesting of live, dead, dying, or high-risk trees would occur. Some salvage harvesting of insect-infested and disease-infected trees would occur, but at a slower, less-effective rate, and not as a result of this analysis or association with this project. Forest stands would maintain dense stocking levels, which contribute to the spread of insects, diseases, and fuel loading, which could lead to high-intensity fires, unnatural forest structures, and overall poor health of the stand.

- ***Cumulative Effects of Action Alternatives B, C, and D to Insects and Diseases***

Timber-management activities on Swan River State Forest, including those proposed to varying extents under each action alternative, have generally implemented prescriptions that would reduce losses and recover mortality due to stem rots, bark beetles, white pine blister rust, western larch dwarf mistletoe, blowdown, and other causes. Older stands are the most susceptible to many of the identified insect and disease problems in the project area due to lack of vigor, stand age, drought, and other factors. Stand regeneration treatments that would bring older stands to a 0-to-39-year age class are producing stands with species compositions more resilient to the impacts of forest insects and diseases and more in line with historic forest conditions. Thinning treatments have further reduced the percentage of infected or infested trees.

Activities on USFS as well as on privately-held ground, including Plum Creek property and small, private landholdings adjacent to Swan River State Forest and the project area, have been mixed. An overall decrease in insects and diseases on Plum Creek may be assumed due to active industrial timber management. Depending on land-management objectives or other mandates, small private landowners or other government agencies may or may not currently employ prescriptions that aim to reduce insect and disease levels on their lands.

FIRE EFFECTS

Issue: The proposed activities may affect forest fire conditions, levels and hazards through tree removal, increased public access, and/or fuel reduction.

EXISTING ENVIRONMENT

Swan River State Forest History

The fire regime across Swan River State Forest is variable. The forest displays a mosaic pattern of age classes and covertypes that have developed due to variations in fire frequency and intensity. In areas that have experienced relatively frequent fires, Douglas-fir, western larch, and ponderosa pine covertypes, with a component of lodgepole pine and western white pine, were produced. As fire frequencies become longer in time, shade-tolerant species (grand fir, subalpine fir, Engelmann spruce, western hemlock, western red cedar) have a better chance to develop. Higher elevation sites within the forest have longer fire frequencies, and the resultant stands are multistoried with a dominant shade-tolerant covertype. Where fire frequencies were short, the stands are open and single-storied, occasionally two-storied. As fire suppression began, covertypes and fire frequencies were altered. Stands of ponderosa pine, western larch, and/or Douglas-fir have become multistoried with shade-tolerant species. Ponderosa pine-dominated stands that were once open now have a thick understory of Douglas-fir. Fires that do occur are generally kept small and natural fire effects are limited. If a larger scale fire were to start, many acres could be affected due to ladder fuels, heavy fuel accumulation, and other environmental factors.

Swan River State Forest has identified 73 fires that have burned 100.8 acres over the last 27 years. On average, 2.7 fires per year occur. Over the last 27 years, 54 lightning fires have burned 73.5 acres, with the largest occurring in 1994 during a dry lightning storm; that fire burned 65 acres in the upper subalpine fir habitat types. Lightning causes approximately 74 percent of all fire starts on Swan River State Forest, and humans cause approximately 26 percent. Human-caused fires are typically started from campfires, debris burning, equipment, or incidents directly related to powerline sparks (*http://mine.mt.gov/f1000/reports.aspx: F1000 Reports*).

Within or adjacent to the project area on the west side of Swan River, 23 fires burned 23.6 acres over the last 27 years. Seventeen out of 23, or 73.9 percent of the fires, were caused by lightning and burned 2.1 acres *(F1000 reports).*

Past research of fire history in Swan Valley has been conducted. The following summaries describe the fire history and the patterns these fires created on the landscape.

Hart (1989) summarized the historical data as follows:

> *Although most of the burns…were of stand-replacement intensity, many less intense fires had also crept over wide areas. The upper (southern) half of Swan valley had been extensively burned, and was blanketed by fallen trees. In this area, fires were moderate, thinning the forest. The lower (northern) Swan also was scarred by fires, but it had a great deal of older mixed forest; species typical of mesic sites were found in this region….*

Antos and Habeck (1981), working mostly in the northern portion of Swan Valley, emphasized the dominance of low-frequency, high-intensity fires (stand-replacement fires) in determining stand patterns:

> *During most summers, the occurrence of frequent rain makes intense fires unlikely; but in some years, dry summers set the stage for large crown fires. Most stands were initiated on large burns…. An average frequency of replacement burns of between 100 and 200 years was characteristic…. Stands over 300 years old do occur, and repeat burns less than 20 years apart have also occurred. In some forests initiated by replacement burns, ground fires have occurred after stand establishment, with variable effects on the overstory. Very wet sites, such as stream bottoms and lower north slopes, often experience partial burns when located within the perimeter of large replacement burns.*

The analysis of fire history indicates that the lower elevations of Swan Valley were burned frequently; in the drier southern half, the intervals were shorter than on the more moist northern part. Between 1758 and 1905, this portion of the range had fire-free intervals of about 30 years, and the presence of western larch and even-aged lodgepole pine suggests the fires were of higher intensity. The remaining samples are from the southern end and these have a shorter interval of 17 years (*Freedman and Habeck, 1984*).

Historical data indicates that forests in Swan River State Forest and the project area were cooler and moister than the broad scale Climatic Section and western Montana averages. They were also considerably older with a far higher proportion of western larch/Douglas-fir covertypes than at the broad scale. Although the forests of Swan

River State Forest were old, the representation of shade-tolerant covertypes was low, indicating disturbance was frequent or recent enough to prevent widespread covertype conversion through succession.

Fire Groups

The project area is represented by 2 different fire regimes that are classified as fire groups: Fire Group 11 and Fire Group 9 (*Fischer and Bradley, 1987*). The project file at the Swan River State Forest office contains information on the other fire groups.

Fires burned in the project area at intervals of 15 to 200-plus years. The various fire intervals and intensities created a mosaic of stands in the forest across the project area. Management in the project area is attempting to mimic, at least in part, historic fire patterns and intensities. The species representation in the project area has also been influenced by fire disturbances. Where feasible, in terms of covertypes (western larch/Douglas-fir, western white pine, etc.), treatments would attempt to move the forest toward desired future conditions and maintain these covertypes by future management activities (*FIGURE V-1 - PROPORTION OF HISTORIC CONDITIONS BY COVERTYPE FOR SWAN RIVER STATE FOREST* and *FIGURE V-2 - CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOREST*).

The project area is represented by Fire Group 11 (78 percent), and Fire Group 9 (22 percent) (*Fischer and Bradley, 1987*).

Seventy-eight percent of the proposed stands fall into Fire Group 11, which represent warm, moist, grand fir, western red cedar, and western hemlock habitat types where fires are infrequent but severe, and the effects are typically stand replacing. Fire free intervals typically range from 100 to 200 years between stand-replacing fires. This fire group has predominately moist conditions, which can allow these areas to serve as a fire break for low-intensity ground fires. The sites are also known to have high fuel loadings, high plant productivity, and, when combined with drought conditions, these lead to severe and widespread fires.

The other fire regime that represents 22 percent of the project area is Fire Group 9. This fire group is characterized by moist, lower subalpine habitat types where fires are infrequent, but severe, and the effects may be long lasting. Past studies show an average fire-free interval of 30 years, with extremes of 10 to 100 years. The dominant representation of ponderosa pine, western larch, and Douglas-fir reflects the relatively high fire frequency. Due to the moisture content of these stands, moderate to severe fires may have been restricted to brief periods in the summer. Flare-ups may have caused openings that allowed the establishment of seral species.

Hazards and Risks in the Project Area

The hazards and risks associated with wildfires include a potential loss of timber resources, effects to watersheds, and loss of property. The majority of timber stands being considered for harvesting are in the mature or older age classes in stands that have not burned since pre-European settlement. Fire hazards in these areas range from above- to near-natural levels with moderate to high accumulations of down and ladder fuels relative to stand densities. Some of the western larch/Douglas-fir stands have a dense understory of grand fir, a significant hazard due to its density and structure and the increased risk that a low-intensity ground fire could develop into a stand-replacing crown fire.

Many of the old-growth stands in the project area are relic stands. Stand-replacing fires have not occurred in the area for 200 or more years. As the stands continue to age and mortality occurs from various biotic and abiotic factors, fuels would accumulate. These stands have an in-growth of shade-tolerant trees, which provide ground and ladder fuels, thus increasing their susceptibility to intense fires, especially during times of drought. Accessible stands have had salvage logging and firewood cutting that has reduced the larger diameter down fuels in the area. The continued encroachment of shade-tolerant trees, accumulations of down woody debris, and mortality increases fire risks.

Increased recreational use in the area is another potential ignition source that may result in a hazardous condition due to fuel accumulation.

Nonindustrial forestland adjacent to the project area has a similar amount of fuel loading. Much of the adjacent USFS ownership has not been managed for several years. The resulting stands have a moderate to high risk of stand-replacement wildfires due to continued heavy fuel loadings.

ENVIRONMENTAL EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Fire Effects***

  The wildfire hazard would not change substantially in the short term. With continued fuel accumulation from down woody debris, the potential for wildfires increases. Large-scale, stand-replacing fires may be the outcome.

  Eventually, due to the continuing accumulation of fine fuels, snags, ladder fuels, and deadwood components, the risk of stand-replacement fires would increase.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Fire Effects***

  Immediately following timber harvesting, the amount of fine fuels would increase. Hazards would be reduced by scattering slash, cutting limbs and tops to within a maximum height to hasten decomposition, spot-piling by machine in openings created by harvesting, and burning landing piles.

  Broadcast burning would be utilized as a site-preparation method in some seedtree units, while others would be treated by simultaneously piling slash and scarifying soil with an excavator, followed by the burning of piles. Scarification and broadcast burning both prepare seedbeds for natural regeneration. Broadcast burning would consume fuels and return nutrients to the soil at a faster rate than unburned areas.

  The hazards of destructive wildfires in these stands would be reduced because larger, more fire-resistant species would be left at wider spacings. Grand fir, some Douglas-fir, western red cedar, and subalpine fir, which pose a higher crown fire hazard because of their low-growing branches and combustible nature, would be removed. This would reduce the potential mortality from low- to moderate-intensity fires, but would not "fireproof" the stands from the high-intensity stand-replacing fires brought on by drought and wind.

Seedtree and shelterwood harvest treatments would reduce wildfire hazards. Regeneration harvests, where slash has been treated, but trees are still small, have proven to be fire resistant in many cases. However, contrary conclusions have been put forth wherein timber harvesting is believed to have increased the risk of wildfires, especially in the short term, where logging slash was not treated. Fire hazards would slowly increase over time as trees reach pole size, crown densities increase, and fuels accumulate.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A on Fire Effects***

The risk of wildfires would continue to increase as a result of long-term fire suppression.

- ***Cumulative Effects of Action Alternatives B, C, and D on Fire Effects***

Fuel loadings would be reduced in treated stands, decreasing wildfire risks in these specific areas.

The Three Creeks 1, 2, 3, and Small Lost timber sales have a combination of broadcast burning and excavator piling and burning to be completed from Fall of 2008 to Fall of 2011. Ongoing salvage sales across Swan River State Forest will also have excavator piling and burning associated with slash at the landings. The net cumulative effect would be a reduction in wildfire risks. The differing management techniques of USFS, Plum Creek, and small, private landowners may result in a slight, net cumulative reduction in wildfire risks as well as simply due to the sheer acreage of the Plum Creek ownership.

SENSITIVE PLANTS

Issue: The proposed activities may affect sensitive plant populations through ground disturbance.

EXISTING ENVIRONMENT

The Montana Natural Heritage Program (http://www.nhp.nris.mt.gov) database was searched in May 2003 for plant species and the habitat that would support these plants in the vicinity of Swan River State Forest. Botanists were contracted to perform a site-specific survey for sensitive plants within Swan River State Forest. Results of this search were compared to the location of proposed harvest sites for potential direct and indirect impacts and the need for mitigation measures was assessed.

The majority of sensitive plants and their related habitat features were found in wet meadows, areas that are not normally classified as forest stands or considered for timber harvesting. The survey identified 9 species of special concern existing within a total of 19 separate populations (*Pierce and Barton 2003*); none of these plant populations are within the harvest units.

ENVIRONMENTAL EFFECTS

Direct and Indirect Effects

No effects are expected because no populations of sensitive plants occur within the harvest units. Typically, these plants are located in such wet areas that activities will not occur within the plant habitat.

Cumulative Effects

- ***Cumulative Effects of All Alternatives to Sensitive Plants***

  If changes occur in the water yield or nutrient level, sensitive plant populations may, in turn, be affected. Given the level of the proposed and active harvesting on Swan River State Forest and other land in the project area, no measurable changes in water yield or surface water levels are anticipated from any of the proposed action alternatives in Whitetail, Woodward, and South Woodward creeks. No change in nutrient levels would occur due to mitigation measures designed to prevent erosion and sediment delivery. USFS lands, as well as Plum Creek property and private, nonindustrial landholdings may have sensitive plant populations on their ownership, and various activities may impact those populations.

NOXIOUS WEEDS

Issue: The proposed activities may affect noxious weed populations and presence through ground disturbance and weed introduction.

EXISTING ENVIRONMENT

Spotted knapweed (*Centaurea mauclosa* Lam.), yellow hawkweed (*Hieracium caespitosum),* orange hawkweed (*Hieracium aurantiacum*), Canada thistle (*Cirsium arvense)*, oxeye daisy (*Chrysanthemum leucanthemum)*, and common St. John's-wort (*Hypericum perforatum* L.) have become established along road edges in the project area. Swan River State Forest has an ongoing program to reduce the spread and occurrence of noxious weeds.

ENVIRONMENTAL EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Noxious Weeds***

  Noxious weed populations would continue as they exist. Weed seed would continue to be introduced by recreational use of the forest and log hauling and other logging activities on adjacent ownerships. Swan River State Forest may initiate spot spraying to reduce noxious weed spread along roads under the FI program.

- ***Direct and Indirect Effects of All Action Alternatives to Noxious Weeds***

  Logging disturbance would provide opportunities for increased establishment of noxious weeds; log hauling and equipment movement would introduce weed seeds from other sites. The occurrence and spread of existing or new noxious weeds would be reduced by mitigation measures in the form of integrated weed-management techniques. Grass seeding of new and disturbed roads and landings and spot spraying of new infestations would reduce or prevent the establishment of new weed populations. Contractors would be required to wash and have machinery inspected prior to entering the project area to reduce the introduction of noxious weed seeds. Roadside herbicide spraying would reduce existing populations of noxious weeds. All herbicide applications would follow label directions, avoid introduction of chemicals into riparian systems, and target only the intended species of noxious weeds.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Noxious Weeds***

  Salvage logging on State land and logging activities on adjacent lands would continue to provide opportunities for noxious weeds to become established. Current population levels would continue to exist and may increase over time.

- ***Cumulative Effects of All Action Alternatives to Noxious Weeds***

  The action alternatives, together with other management and recreational activities on Swan River State Forest, would provide an opportunity for the transfer of weed seed and increased establishment of noxious weeds. Preventative actions facilitated by the Lake County Weed Board and active weed-management activities performed by Swan River State Forest would reduce the spread and establishment of noxious weeds, as well as the impacts resulting from the replacement of native species. Swan River State Forest would continue to perform weed management through this action depending on funding levels. Plum Creek works in conjunction with Swan River State Forest to treat noxious weeds; therefore, treatment of noxious weeds could be expected on adjacent parcels under their ownership. Private, nonindustrial landowners may continue to transfer weed seed through vehicle travel and lack of weed management.

INTRODUCTION

PROJECT AREA AND PROJECT ACTIVITIES

The gross project area (see *CHAPTER I – PURPOSE AND NEED* for project area) includes 6,295 acres within Swan River State Forest. Affected watersheds include the East Porcupine Creek, Whitetail Creek, Woodward Creek, and South Woodward Creek watersheds in the Swan River drainage. Each watershed includes land managed by FNF, Plum Creek, and DNRC. Areas outside of the listed watersheds are also included in the proposed project area. The proposed action alternatives would include a combination of ground-based and cable yarding methods to harvest timber on a range of 1,186 to 1,563 acres within the project area. Infrastructure for the proposed action would require new construction of temporary and permanent roads to access the proposed harvest areas. All proposed road construction would be done outside of the SMZ, except to cross a stream.

RESOURCE DESCRIPTION

Water yield and sediment delivery will be assessed in this analysis. Water yield increases can affect channel stability if dramatically altered. Sediment delivery from both in-channel and introduced sources is a primary component of overall water quality in a watershed.

ISSUES AND MEASUREMENT CRITERIA

The following issues encompass the specific issues and concerns raised through public comment and scoping of the proposed project. A specific list of individual comments and concerns can be found in the project file at the Swan River State Forest headquarters.

Sediment Delivery

Timber harvesting and related activities, such as road construction, can lead to water-quality impacts by increasing the production and delivery of fine sediment to streams. Construction of roads, skid trails, and landings can generate and transfer substantial amounts of sediment through the removal of vegetation and exposure of bare soil. In addition, removal of vegetation near stream channels reduces the sediment-filtering capacity and may reduce channel stability and the amounts of large woody material. Large woody debris is a very important component of stream dynamics, creating natural sediment traps and energy dissipaters to reduce the velocity and erosive power of stream flows. Other aspects of sediment analysis can also be found in the fisheries analysis portion of this document.

Measurement Criteria: Number of tons of sediment delivery per year using procedures adapted from the Washington Forest Practices Board (*Callahan 2000*). Sediment from harvesting activities and vegetative removal will be analyzed qualitatively through data collected in the BMP audit process.

Water Yield

Timber harvesting and associated activities can affect the timing, distribution, and amount of water yield in a harvested watershed. Water yields increase proportionately to the percentage of canopy removal (*Haupt 1976*), because removal of live trees reduces the amount of water transpired, leaving more water available for soil saturation and runoff. Canopy removal also decreases interception of rain and snow and alters snowpack distribution and snowmelt, which lead to further water-yield increases. Higher water yields may lead to increases in peak flows and peak-flow duration, which can result in accelerated streambank erosion and sediment deposition. Vegetation removal can also reduce peak flows by changing the timing of snowmelt. Openings will melt earlier in the spring with solar radiation and have less snow available in late spring when temperatures are warm. This effect can reduce the synchronization of snowmelt runoff and lower peak flows.

Measurement criteria: Equivalent Clearcut Acres (ECA). All past and proposed timber management activities are converted to ECA using procedures outlined in *Forest Hydrology Part II (Haupt 1976*). Peak flow duration and timing will be addressed qualitatively.

ANALYSIS AREA

Sediment Delivery

Direct, indirect, and cumulative effects to sediment delivery will be analyzed in each of the 4 project area watersheds listed in the *PROJECT AREA AND PROJECT ACTIVITIES* at the beginning of this analysis. All existing and proposed road-construction activities related to the project area on all ownerships in each project-area watershed will be analyzed using procedures adapted from the Washington Forest Practices Board (*Callahan 2000*). These watersheds were chosen as an appropriate scale of analysis for the Washington Forest Practices method and will effectively display the estimated impacts of the proposed activities. Additional sites not located in the project-area watershed boundaries will be assessed qualitatively for their potential to affect downstream water.

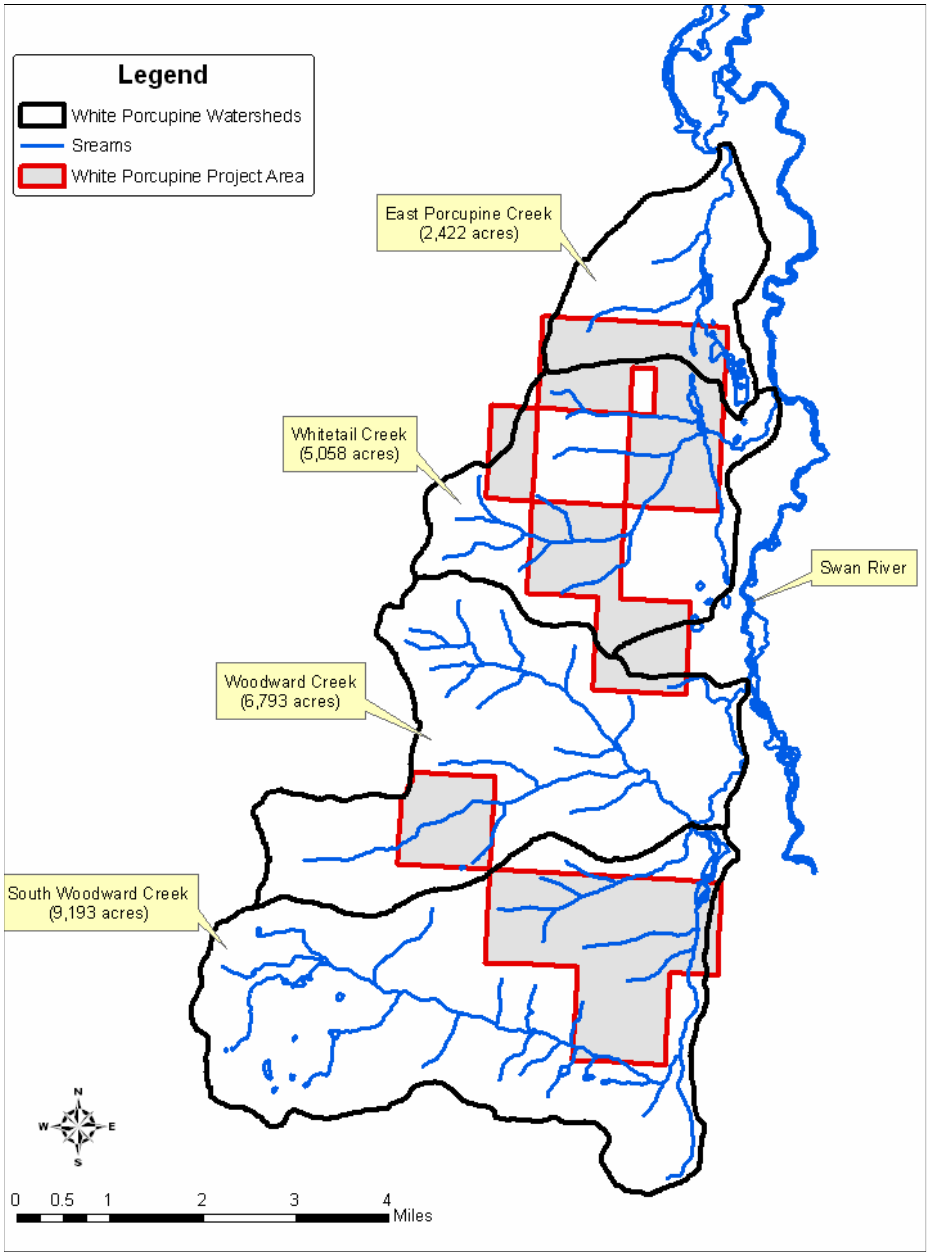
Water Yield

Direct, indirect and cumulative effects to water yield will be analyzed in each of the 4 watersheds listed under *PROJECT AREA AND PROJECT ACTIVITIES* at the beginning of this analysis. A map of these watersheds and their relation to the proposed project area is found below in *FIGURE H-1 – PROJECT AREA WATERSHEDS*. All existing activities on all ownerships and proposed activities related to the Whitetail Porcupine project, including road construction, within each of these watersheds will be analyzed using the ECA method to estimate the water-yield changes that may occur as a result of the proposed project. These watersheds were chosen as an appropriate scale of analysis for the ECA method, and will effectively display the estimated impacts of proposed activities. A qualitative assessment of water yield will be done for areas outside of the 4 watersheds listed under *PROJECT AREA AND PROJECT ACTIVITIES* at the beginning of this analysis.

ANALYSIS METHODS

Each of the analyses below was conducted on a watershed basis, and included activities on all roads and acres, regardless of ownership. For the cumulative-effects analyses, all proposed DNRC activities and proposed actions on other ownerships were considered. Potential future management on other ownerships was not considered due to the speculative nature of predicting the intentions of other landowners. For a complete list of past activities considered in this analysis, please refer to *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* under *SCOPE OF THE EIS* in *CHAPTER I*.

FIGURE H-1 – PROJECT-AREA WATERSHEDS



Sediment Delivery

Methodology for analyzing sediment delivery was completed using a sediment-source inventory. All roads and stream crossings were evaluated to determine sources of introduced sediment. Data were collected in 2007 to quantify sediment delivery from roads using procedures adapted from the Washington Forest Practices Board (*Callahan, 2000*). In addition, in-channel sources of sediment were identified using channel-stability rating methods developed by *Pfankuch* (*1975*) and through the conversion of stability ratings to reach condition by stream type developed by *Rosgen* (*1996*). These analyses were conducted in 1998 and 1999 by a DNRC hydrologist; the results were verified in 2007 to ensure the validity of the results.

Water Yield

The water-yield increase for the watershed in the project area was determined using the ECA method as outlined in *Forest Hydrology Part II* (*Haupt 1976*). ECA is a function of total area roaded and harvested, percent of crown removal in harvesting, and amount of vegetative recovery that has occurred in harvest areas. This method equates area harvested and percent of crown removed with an equivalent amount of clearcut area. For example, if 100 acres had 60 percent crown removed, ECA would be approximately 60, or equivalent to a 60-acre clearcut. The relationship between crown removal and ECA is not a 1-to-1 ratio, so the percent ECA is not always the same as the percent of canopy removal. As live trees are removed, the water they would have evaporated and transpired either saturates the soil or is translated to runoff. This method also calculates the recovery of these increases as new trees begin to grow and move toward preharvest water use.

In order to evaluate the watershed risk of potential water-yield increase effectively, a threshold of concern must be established. In order to determine a threshold of concern, acceptable risk level, resource value, and watershed sensitivity are evaluated according to *Young (1989)*. The watershed sensitivity is evaluated using qualitative assessments, as well as procedures outlined in *Forest Hydrology Part II* (*Haupt 1976*). The stability of a stream channel is an important indicator of where a threshold of concern should be set. As water yields increase as a result of canopy removal, the amount of water flowing in a creek gradually increases. When these increases reach a certain level, the bed and banks may begin to erode. More stable streams will be able to handle larger increases in water yield before they begin to erode, while less stable streams will experience erosion at more moderate water-yield increases (*Rosgen 1996*).

Risk Assessment Criteria

Where risk is assessed in both sediment-delivery and water-yield analyses, the following definitions apply to the level of risk reported:

- low risk means impacts are unlikely to result from proposed activities,
- moderate risk means there is approximately a 50-percent chance of impacts resulting from proposed activities, and
- high risk means impacts are likely to result from proposed activities.

Where levels or degrees of impacts are assessed in this analysis, the following definitions apply to the degree of impacts reported:

- very low impact means impacts from proposed activities are unlikely to be measurable or detectable and are not likely to be detrimental to the water resource;
- low impact means impacts from proposed activities would likely be measurable or detectable, but are not likely to be detrimental to the water resource;
- moderate impact means impacts from proposed activities would likely be measurable or detectable and may or may not be detrimental to the water resource;
- high impact means impacts from proposed activities would likely be measurable or detectable and are likely to have detrimental impacts to the water resource.

RELEVANT AGREEMENTS, LAWS, PLANS, RULES, AND REGULATIONS

Montana Surface Water-Quality Standards

According to *ARM 17.30.608* (*1*)(*b*)(*i*), the Swan River drainage, including East Porcupine, Whitetail, Woodward, and South Woodward creeks, is classified as B-1. Among other criteria for B-1 waters, no increases are allowed above naturally occurring levels of sediment, and minimal increases over natural turbidity. "Naturally occurring," as defined by *ARM 17.30.602* (*19*), includes conditions or materials present during runoff from developed land where all reasonable land, soil, and water conservation practices (commonly called BMPs) have been applied. Reasonable practices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after completion of activities that could create impacts.

Designated beneficial water uses within the project area include cold-water fisheries and recreational use in streams, wetlands, and lakes in the surrounding area. Two existing surface water rights for domestic use are in the project area on Woodward Creek. Domestic use refers to water rights assigned to individual property owners for uses such as eating, drinking, laundering, bathing, lawn watering, and watering a household garden.

Water-Quality-Limited Waterbodies

None of the streams in the proposed project area are currently listed as water-quality-limited waterbodies in the *2006 Montana 303* (*d*) list. Swan Lake is currently listed on the *2006 Montana 303(d)* list. Each of the project area watersheds is a tributary to Swan River, which is the primary inflow to Swan Lake. The 303(d) list is compiled by the DEQ as required by *Section 303*(*d*) of the *Federal Clean Water Act* and the *EPA Water Quality Planning and Management Regulations* (*40 CFR, Part 130*). Under these laws, DEQ is required to identify waterbodies that do not fully meet water-quality standards or where beneficial uses are threatened or impaired. These waterbodies are then characterized as "water quality limited" and thus targeted for Total Maximum Daily Load (TMDL) development. The TMDL process is used to determine the total allowable amount of pollutants in a waterbody of a watershed. Each contributing source is allocated a portion of the allowable limit. These allocations are designed to achieve water-quality standards.

The *Montana Water Quality Act* (*MCA 75-5-701* through *705*) also directs DEQ to assess the quality of State waters, ensure that sufficient and credible data exists to support a 303(d) listing, and develop TMDL for those waters identified as threatened or impaired. Under the Montana TMDL Law, new or expanded nonpoint source activities affecting a listed waterbody may commence and continue provided they are conducted in accordance with all reasonable land, soil, and water conservation practices. DNRC will comply with the TMDL Law and interim guidance developed by DEQ through implementation of all reasonable soil and water conservation practices, including BMPs and Forest Management Rules (*ARM 36.11.401 through 450*).

Swan Lake is currently listed as threatened for aquatic life support and cold-water fisheries. The current listed cause of impairment in Swan Lake is sedimentation/ siltation; the probable sources include forest roads (road construction and use), highways, roads, bridges, and infrastructure (new construction). Through the Swan Lake Watershed Group and its associated Swan Lake Technical Advisory Group, a water-quality restoration plan was developed for Swan Lake in June 2004. These two groups are comprised of local stakeholders and include:

- the Swan Ecosystem Center, Flathead Lake Biological Station at Yellow Bay, and Friends of the Wild Swan;
- landowners, including USFS, DNRC, Plum Creek; and
- regulatory agencies, including DEQ and the EPA.

The *Water Quality Restoration Plan* was approved by EPA in August 2004; activities are ongoing to correct current sources and causes of sediment to Swan Lake and its tributaries. DNRC is an active partner and participant in this process. All proposed activities within the project area would implement activities to alleviate identified sources of sediment and comply fully with all TMDL requirements.

Montana SMZ Law

By the definition in *ARM 36.11.312* (*3*), the majority of the stream reaches in the Whitetail, Woodward, and South Woodward watersheds are Class 1 streams. All of these streams and many of their tributaries have flow for more than 6 months each year. Many of these stream reaches also support fish. Some of the smaller first-order tributaries may be classified as Class 2 or 3 based on site-specific conditions. A Class 3 stream is defined as a stream that does not support fish; normally has surface flow during less than 6 months of the year; and rarely contributes surface flow to another stream, lake, or other body of water (*ARM 36.11.312* (*5*)). According to *ARM 36.11.312 (4)*, a Class 2 stream is a portion of a stream that is not a Class 1 or Class 3 stream segment.

Forest Management Rules

In 2003, DNRC drafted Administrative Rules for Forest Management. The portion of those rules applicable to watershed and hydrology resources include *ARM 36.11.422* through *426*. All applicable rules will be implemented if they are relevant to activities proposed with this project.

EXISTING ENVIRONMENT

INTRODUCTION

The watersheds in the proposed project area include South Woodward, Woodward, Whitetail, and East Porcupine creeks. Each drainage lies on the east slope of the Mission Range and form a portion of the western geologic boundary of Swan Valley. Precipitation ranges from approximately 20 inches annually in the valley bottom to approximately 70 inches near ridge tops. Due to the east-facing nature of these drainages, the high occurrence of springs and groundwater upwelling, and the underlying geology, stream flows are generally very stable and are not "flashy" during spring runoff. Stream-gauging data gathered since 1976 on project area streams show that peak discharge in streams on the west side of Swan Valley is approximately double that of summer low flows. In comparison, streams on the east side of the valley gauged on the same dates show approximately a 5-fold increase from low flow to peak discharge. The result of these stable flows is generally high channel and bank stability. These and other attributes will be described in more detail in the following sections.

SEDIMENT DELIVERY

Reviews of in-channel and out-of–channel sediment-source were conducted by DNRC hydrologists and fisheries biologists in 1998 and 2007, and by PBS&J Consulting in association with the development of the *Swan Lake Water Quality Protection Plan* and TMDL (*DEQ 2005*). The results of these assessments were used in the following sections of this analysis.

- **South Woodward Creek In-channel Sources**

  Based on field reconnaissance from 1998 through 2000 and 2007, stream channels in the South Woodward Creek watershed are primarily in good to fair condition (*Rosgen 1996*). One reach was rated in poor condition and is located where the stream gradient changes dramatically. This reach becomes a depositional area where upstream sediment transport reaches deposit material. The reach represents less than 5 percent of the total length of streams in the watershed and is located on Plum Creek lands. Portions of the proposed project area are found upstream from this reach, but most of the proposed project area is located downstream.

  Using a classification system developed by *Rosgen* (*1996*), most reaches of South Woodward Creek were rated as B2 and B3 channels, and many of the perennial tributaries to South Woodward Creek were rated as B4. Channel types rated as "B" are typically in the 2- to 4-percent gradient range, and have a moderate degree of meander (sinuosity). Channel-bed materials in B2 and B3 types are mainly boulder and cobble, respectively, and channel-bed materials in B4 types are mainly gravel. Given the cobble and gravel content and the gradient of these stream types, bed materials commonly move. Gravel bars have formed on point bars in these reaches (point bars are areas of natural deposition found on the inside of a meander bend). No areas of down-cut channels were identified during field reconnaissance. Large woody debris was found in adequate supply to support channel form and function. Woody material in a stream provides traps for sediment storage and gradient breaks to reduce erosive energy and work as flow deflectors to reduce bank erosion. Large woody debris is also assessed for its ability to provide habitat for aquatic species. These issues are discussed further in the fisheries portion of this document. Little evidence of past SMZ harvesting was found; where past logging did take place in the SMZ, no deficiency of existing or potential downed woody material to support hydrologic function was apparent in the streams. The fisheries analysis has a more in-depth analysis of large woody debris, including a discussion of reference stream conditions.

- **Woodward Creek In-channel Sources**

  Based on field reconnaissance from 1998 through 2000 and 2007, most stream reaches in the Woodward Creek watershed were rated in good to fair condition (*Rosgen 1996*). Four reaches were rated in poor condition. These reaches were all moderate to moderately high gradient channels in gravel or sand substrate. Channels with dominant substrate sizes in the gravel and sand ranges have less resistance to erosive flows, especially in steeper gradient channels. These reaches represent approximately 25 percent of the total length of streams in the watershed and are located mainly on DNRC-managed lands.

Stream reaches in the upper portions of the watershed are mainly B4 channel types, with minor amounts of B5 and B6 channels using a classification system developed by *Rosgen* (*1996*). Channel types rated as "B" are typically in the 2- to 4-percent gradient range and have a moderate degree of meander (sinuosity). Channel-bed materials in B4 and B5 types are mainly gravel or sand, respectively, and channel-bed materials in B6 types are mainly silt/clay. Stream reaches are mainly C4 and C5 in the lower portions of the watershed. Channel types rated as "C" are typically in the 1- to 2-percent gradient range, and have a high degree of meander (sinuosity). Channel-bed materials in C4 and C5 channels are mostly gravel and coarse sand, respectively. Given the gravel and coarse sand beds and the gradient of these stream types, bed materials commonly move. No areas of down-cut channels were identified during field reconnaissance. Large woody debris was found in adequate supply to support channel form and function. Woody material in a stream provides traps for sediment storage and gradient breaks to reduce erosive energy and work as flow deflectors to reduce bank erosion. Large woody debris is also assessed for its ability to provide habitat for aquatic species. Little evidence of past SMZ harvesting was found; where past logging did take place in the SMZ, no deficiency of existing or potential downed woody material was apparent in the streams. These issues are discussed further in the fisheries portion of this document.

- **Whitetail Creek In-channel Sources**

Based on field reconnaissance from 2000 and 2007, stream channels in the Whitetail Creek watershed are primarily in good condition. No reaches of Whitetail Creek were rated in poor condition.

Most reaches of the channel were classified as B3 and B4 using a classification system developed by *Rosgen* (*1996*). Channel types rated as "B" are typically in the 2- to 4-percent gradient range and have a moderate degree of meander (sinuosity). Channel bed materials in B3 types are mainly cobble with some boulders and gravel, and bed materials in B4 types are mainly gravel with some cobble and sand. No areas of down-cut channels were identified during field reconnaissance. Large woody debris was found in adequate supply to support channel form and function. Woody material in a stream provides traps for sediment storage and gradient breaks to reduce erosive energy and work as flow deflectors to reduce bank erosion. Large woody debris is also assessed for its ability to provide habitat for aquatic species. These issues are discussed further in the fisheries portion of this document. The lower reaches of the watershed flow through a series of wetlands and beaver ponds. The beaver dams can lead to changing water levels in the stream, but the wetlands and beaver ponds tend to moderate the high runoff periods and settle out sediment and channel bed materials that may be carried downstream during runoff. Little evidence of past SMZ harvesting was found; where past logging did take place in the SMZ, no deficiency of existing or potential downed woody material was apparent in the streams.

- **East Porcupine Creek In-channel sources**

No channel stability data were gathered for the East Porcupine Creek watershed because no stream channels were identified within this portion of the proposed project area. As a result, no further analysis of in-channel or road-related sediment delivery will be conducted for the East Porcupine Creek watershed.

- **Road System**

The existing road system located within and leading to the proposed project area was reviewed in 2007 for existing and potential sources of sediment. Based on the sediment-source review, several existing sources of sediment were identified on the existing road system. Each of the sources identified in this analysis are either found on DNRC ownership or are associated with roads that are under a Cost-Share Agreement entered into by DNRC and Plum Creek. Most of the delivery sites are located at stream crossings. The total estimated sediment delivery from roads in the project area to South Woodward, Woodward, and Whitetail creeks are displayed in *TABLE H-1 – CURRENT SEDIMENT DELIVERY*. These sediment-delivery values are estimates based on procedures outlined above and are not measured values.

Estimated sediment delivery occurs primarily at stream crossings, and sediment comes from a variety of sources. Approximately 16 of the 23.6 tons of delivery estimated in the South Woodward watershed come from 2 sites on Plum Creek land located well outside of the proposed project area. These crossings are located on seasonally closed roads that receive traffic annually.

TABLE H-1 - CURRENT SEDIMENT DELIVERY. *Current estimated sediment delivery to project area streams.*

	SOUTH WOODWARD CREEK	WOODWARD CREEK	WHITETAIL CREEK
Existing tons per year	23.6	3.5	5.9

Whitetail Creek has a wooden bridge with log crib-type abutments that was constructed in the 1960s; the wood is very rotten and the bridge decking is starting to collapse. Currently, a portable steel bridge has been placed over the top of this bridge, but the old structure is rapidly decaying. This site is not a major source of sediment in the watershed, but the bridge is a high risk of failure due to the decay of the wood. Each abutment is supporting 8 to 10 tons of fill material that would be washed into the creek should they fail.

The 2 existing stream-crossing structures on Whitetail Creek in Section 26 of the proposed project area are improperly designed and functioning poorly. One is a fish-passage barrier and is not properly sized for the site. Fill material is too close to the ends of the pipe, and the structure has high potential for sediment delivery. The other was bedded poorly and has separated at its band, which has led to a large sink-hole in the middle of the fill. All of the fill material that has come out of the fill section has washed into the stream; the site is a chronic and potential source of sediment delivery. This pipe is also too short, so fill material is too close to the ends of the pipe, which is another potential sediment source to Whitetail Creek.

Other sources of sediment delivery found during the inventory are minor and located on sites needing additional road surface drainage and BMP upgrades. These sites are found mainly on older roads that were constructed before the adoption of forest management BMPs. Some sites have BMPs in place, but are not functioning as designed due to maintenance. These sites are also responsible for some of the smaller delivery sources.

Much of the existing road system in the proposed project area meets applicable BMPs. Surface drainage and erosion-control features were installed on the road systems in most of the South Woodward Creek and Woodward Creek watersheds through recent past project work.

- ***WATER YIELD***

According to *ARM 36.11.423*, allowable water-yield increase values were set at levels to ensure compliance with all water-quality standards, protect beneficial uses, and exhibit a low degree of risk. This means that the allowable level is a point below which water yields are unlikely to cause any measurable or detectable changes in channel stability. The allowable water-yield increase for the South Woodward Creek watershed has been set at 12 percent based on channel-stability evaluations, watershed sensitivity, and acceptable risk. This water-yield increase would be reached approximately when the ECA in South Woodward Creek reaches the estimated level of 2,758 acres. The allowable water-yield increase for the Woodward Creek watershed has been set at 12 percent based on channel-stability evaluations, watershed sensitivity, and acceptable risk. This water-yield increase would be reached approximately when the ECA level in Woodward Creek reaches the estimated level of 2,038 acres. The allowable water-yield increase for the Whitetail Creek watershed has been set at 12 percent based on channel-stability evaluations, watershed sensitivity, and acceptable risk. This water-yield increase would be reached approximately when the ECA level in Whitetail Creek reaches the estimated level of 1,517 acres. The allowable water-yield increase for the East Porcupine Creek watershed has been set at 15 percent based on watershed sensitivity and acceptable risk. This water-yield increase would be reached approximately when the ECA level in East Porcupine Creek reaches the estimated level of 908 acres. Based on review of 1966 aerial photography and DNRC section records of the project area, timber-harvesting and associated road-construction activities have taken place in the South Woodward Creek, Woodward Creek, Whitetail Creek, and East Porcupine Creek watersheds since the 1950s. Harvesting activities may have occurred prior to the 1950s, but no records have been found. Any timber management taking place prior to the

1950s is assumed to have returned to preactivity levels of transpiration and snowpack distribution (*Haupt 1976*). In addition, an assessment of past timber management on Plum Creek land in each of the project area watersheds was conducted using aerial photography, GIS, and historical knowledge. Timber management history on land administered by FNF was also included for each of the project area watersheds. These activities, combined with the vegetative recovery have led to an estimated 8.3 percent water-yield increase over a fully forested condition in the South Woodward Creek watershed, 7.2 percent over a fully forested condition in Woodward Creek, 7.4 percent over a fully forested condition in Whitetail Creek, and 6.6 percent over a fully forested condition in East Porcupine Creek. *TABLE H-2 – CURRENT WATER YIELD* summarizes the existing conditions for water yield and the associated ECA levels in the project area watersheds. Estimated water yield and ECA levels are well below established thresholds in all project-area watersheds.

ENVIRONMENTAL EFFECTS

SEDIMENT DELIVERY

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Sediment Delivery***

  No direct effects to sediment delivery beyond those currently occurring. Existing sources of sediment, both in-channel and out of channel would continue to recover or degrade based on natural or preexisting conditions.

  Indirect effects of No-Action Alternative A would be an increased risk of sediment delivery to streams from crossings that do not meet applicable BMPs. These sites would continue to pose a moderate risk of sediment delivery to streams until other funding became available to repair them.

- ***Direct and Indirect Effects to Sediment Delivery Common to Action Alternatives B, C, and D***

  Each of the proposed action alternatives would remove the wooden bridge over Whitetail Creek on Lower Whitetail Road, stabilize the site, and install a new permanent bridge structure at the site. Replacement of the existing bridge over Whitetail Creek would involve removal of the log crib walls and the fill material they are retaining. The existing structure is decaying and is an increasing risk of

TABLE H-2 – CURRENT WATER YIELD. Water yield and ECA increases in project area watersheds.

	SOUTH WOODWARD CREEK	WOODWARD CREEK	WHITETAIL CREEK	EAST PORCUPINE CREEK
Existing percent of water-yield increase	8.3	7.2	7.4	6.6
Allowable percent of water-yield increase	12	12	12	15
Existing ECA	1,772	1,150	756	340
Allowable ECA	2,758	2,038	1,517	908

failure due to decay in the wood. A potential failure of the wood cribbing could allow 8 to 10 tons of sediment to enter the stream. The proposed new bridge would be designed to allow the stream to flow freely through with no constriction of the bank-full channel. This would reduce the potential for bank erosion and channel down-cutting that may occur with vertical bridge abutments. In the short term, increases in the risk of sediment delivery at this site would increase. This risk would be highest in the year immediately following construction activities and would decrease within 2 to 3 years to below preproject levels as bare soil revegetates. The construction activity would produce some direct sediment delivery, but this would be minimized through applying sediment-control measures as prescribed by a DNRC hydrologist and fisheries biologist and a DFWP fisheries biologist.

Each action alternative would also replace 2 existing culvert crossings on Whitetail Creek in Section 26 of the proposed project area with properly sized structures. The replacement of existing stream crossings would contribute sediment directly to the streams where work would be conducted. This sediment would be minimized through application of standard erosion-control measures. The sediment delivery anticipated from this project would be short term and would comply with all applicable permits and State water-quality laws. In addition, several sites would have additional erosion control added to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

Five existing stream crossings outside of the project-area watersheds listed in the *ANALYSIS AREA* portion of this analysis would be used for log hauling in each of the action alternatives. Two of these crossings are bridges (Swan River and Cedar Creek), and 3 are culverts (unnamed tributaries to Swan River). Each of these crossings meets applicable BMPs and would have existing BMPs maintained or enhanced throughout the proposed activities. At the Swan River bridge, a very low risk of low impacts to sediment delivery would occur as a result of proposed haul traffic. At the Cedar Creek bridge, a low to moderate risk of low impacts to sediment delivery would occur as a result of proposed haul traffic. At the culverts on the unnamed tributaries to Swan River, a very low risk of low impacts to sediment delivery would occur as a result of proposed haul traffic.

Development of a new gravel pit is proposed under each action alternative. This proposed gravel pit is located in the southwest portion of Section 24, T23N R18W. The proposed location is between 2 existing roads, and is further than 200 feet from any stream, wetland, or other body of water. Due to the lack of surface water near this proposed gravel pit, a very low risk of low impacts to sediment delivery would occur from the development of a gravel pit and rock-crushing operation.

- ***Direct and Indirect Effects of Action Alternative B to Sediment Delivery***

  Several stream crossings would be replaced as described in *DIRECT AND INDIRECT EFFECTS TO SEDIMENT DELIVERY COMMON TO ACTION ALTERNATIVES B, C, AND D*, and erosion control and BMPs would be improved on a maximum of 74 miles of existing road. This work would:

  - reduce the estimated sediment load to South Woodward Creek by approximately 4.2 tons of sediment per year;
  - reduce the estimated sediment load to Woodward Creek by approximately 1.4 ton per year; and
  - reduce the estimated sediment load to Whitetail Creek by approximately 4.5 tons per year.

  These projected sediment reductions are net values for each watershed. These values include the projected increases in sediment delivery from new stream crossings and new road construction, as well as projected sediment reductions from BMP improvements and road and stream-crossing improvement activities. A more detailed summary of sediment delivery estimates is found in *TABLE H-3* (*4,5*) *– SOUTH WOODWARD* (*WOODWARD, WHITETAIL*) *DELIVERY*.

  Action Alternative B would also construct approximately 14.0 miles of new road to access proposed harvest units. The impacts of proposed new roads are primarily associated with new stream crossings. These impacts are discussed below and in *TABLE H-3* (*4,5*) *– SOUTH WOODWARD* (*WOODWARD, WHITETAIL*) *DELIVERY*. The remainder of the impacts of new road construction is related to the risk of erosion resulting from exposure of bare soil. The risk of sediment delivery from new permanent roads is low where these roads are located away from stream crossings. As cut slopes and fill slopes revegetate, this risk would decrease. The installation of surface drainage and implementation of other BMPs and Forest Management Rules would further reduce the risk of erosion or sediment delivery from new roads.

TABLE H-3 – SOUTH WOODWARD DELIVERY. Estimates of sediment delivery in the South Woodward Creek watershed.

	ALTERNATIVE			
	A	**B**	**C**	**D**
Existing delivery (tons/year)[1]	23.6	23.6	23.6	23.6
Estimated reduction[2]	0.0	4.2	0	3.4
Estimated increase[3]	0.0	0.0	0.0	0.0
Postproject delivery (tons/year)	23.6	19.4	23.6	20.2
Reduction (tons/year)[1]	0	4.2	0	3.4
Percent reduction[4]	0	18	0	14

[1]*These sediment-delivery values are estimates based on procedures outlined in Analysis Methods, and are not measured values.*

[2]*Includes projected decreases from rehabilitation and BMP work on existing roads and crossings.*

[3]*Includes projected increases from construction of new roads and new stream crossings.*

[4]*Percent reduction values are estimates based on procedures outlined in Analysis Methods, not on measured values*

TABLE H-4 – WOODWARD DELIVERY. Estimates of sediment delivery in the Woodward Creek watershed.

	ALTERNATIVE			
	A	B	C	D
Existing delivery (tons/year)[1]	3.5	3.5	3.5	3.5
Estimated reduction[2]	0.0	1.5	1.6	1.7
Estimated increase[3]	0.0	0.1	0.0	0.1
Postproject delivery (tons/year)	3.5	2.1	1.9	1.9
Reduction (tons/year)[1]	0	1.4	1.6	1.6
Percent reduction[4]	0	40	46	46

[1]These sediment-delivery values are estimates based on procedures outlined in Analysis Methods, and are not measured values.
[2]Includes projected decreases from rehabilitation and BMP work on existing roads and crossings.
[3]Includes projected increases from construction of new roads and new stream crossings.
[4]Percent reduction values are estimates based on procedures outlined in Analysis Methods, not on measured values

TABLE H-5 – WHITETAIL DELIVERY. Estimates of sediment delivery in the Whitetail Creek watershed.

	ALTERNATIVE			
	A	B	C	D
Existing delivery (tons/year)[1]	5.9	5.9	5.9	5.9
Estimated reduction[2]	0.0	4.5	4.7	4.6
Estimated increase[3]	0.0	0.0	0.0	0.0
Postproject delivery (tons/year)	5.9	1.4	1.2	1.3
Reduction (tons/year)[3]	0	4.5	4.7	4.6
Percent reduction[4]	0	76	80	78

[1]These sediment-delivery values are estimates based on procedures outlined in Analysis Methods, and are not measured values.
[2]Includes projected decreases from rehabilitation and BMP work on existing roads and crossings.
[3]Includes projected increases from construction of new roads and new stream crossings.
[4]Percent reduction values are estimates based on procedures outlined in Analysis Methods, not on measured values

Action Alternative B proposes 1 new stream crossing, which would be installed in the upper reaches of Woodward Creek in Section 16 of the proposed project area. This crossing would be located in a deep "V"-shaped valley with steep sideslopes (60 to 80 percent). Due to the steepness of the sideslopes coming into the proposed crossing, cutslopes would be much higher than those on standard stream crossings. This type of road construction required on the road approaches does not use fill material; all material cut in order to construct these portions of road would be hauled away in trucks, so the only risk to assess at this site is associated with the cutslopes and road travel surface. This increase in cutslope height would increase the risk of cutslope material being eroded and routed to streams. The soil parent material is glacial till at these sites, which also may increase the risk of material either being eroded or having small cutslope failures fill and plug the road ditches. With all applicable BMPs in place at this site, the risk of erosion problems sending sediment to the stream is moderate, that there is approximately a 50-percent chance that impacts may occur as a result of construction. Potential impacts to water quality are moderate. Therefore, if impacts would occur, they would be detectable or measurable, and these impacts may or may not be detrimental to downstream beneficial uses. If a culvert is used as a crossing structure at this site, fill depths in this type of draw are typically deep and can generate large areas of bare fill material. Fill slopes like these present a moderate risk of moderate impacts for several years until the site is vegetated. Once vegetated, the fill would present a low risk of low impacts to the stream. If a bridge were installed at this site, the fill volumes and bare soil area would be greatly reduced. A bridge would carry a moderate risk of sediment delivery, but with reduced bare soil for erosion the impacts would be low.

Action Alternative B would have a low risk of sediment delivery to streams as a result of the proposed timber-harvesting activities. The SMZ law, Administrative Rules for Forest Management, and applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. The Montana BMP audit process has been used to evaluate the application and effectiveness of forest-management BMPs since 1990; this process has also been used to evaluate the application and effectiveness of the SMZ Law since 1996. During that time, evaluation of ground-based-skidding practices near riparian areas has been rated 92-percent effective, and these same practices have been found effective over 99 percent of the time from 1998 to present (*DNRC 1990* through *2006*). Since 1996, effectiveness of the SMZ width has been rated over 99 percent (*DNRC 1990* through *2004*). As a result, with the application of BMPs and the SMZ Law, proposed activities are expected to have a low risk of low impacts to sediment delivery. Action Alternative B proposes no timber harvesting within an SMZ or RMZ.

- ***Direct and Indirect Effects of Action Alternative C to Sediment Delivery***

Several stream crossings would be replaced as described in *Direct and Indirect Effects to Sediment Delivery Common to Action Alternatives B, C and D*, and erosion control and BMPs would be improved on up to 41 miles of existing road. This work would:

- reduce the estimated sediment load to Woodward Creek by approximately 1.6 ton per year; and
- reduce the estimated sediment load to Whitetail Creek by approximately 4.7 tons per year.

These projected sediment reductions are net values for each watershed. These values include the projected increases in sediment delivery from new road construction, as well as projected sediment reductions from BMP improvements and road and stream-crossing improvement activities. No new stream crossings are proposed and no road construction, BMP improvements, or hauling are proposed in the South Woodward Creek watershed with Action

Alternative C. A more detailed summary of sediment delivery estimates is found in *TABLE H-3* (*4, 5*) – *SOUTH WOODWARD* (*WOODWARD, WHITETAIL*) *DELIVERY*.

Action Alternative C would also construct approximately 9.5 miles of new road to access proposed harvest units. The impacts of proposed new roads are primarily associated with new stream crossings. These impacts are discussed below and in *TABLE H-3* (*4,5*) – *SOUTH WOODWARD* (*WOODWARD, WHITETAIL*) *DELIVERY*. No new stream crossings are proposed with this alternative. The remainder of the impacts of new road construction is related to the risk of erosion resulting from exposure of bare soil. The risk of sediment delivery from new permanent roads is low where these roads are located away from stream crossings. As cut slopes and fill slopes revegetate, this risk would decrease. The installation of surface drainage and implementation of other BMPs and Forest Management Rules would further reduce the risk of erosion or sediment delivery from new roads.

This alternative would have a low risk of sediment delivery to streams as a result of proposed timber-harvesting activities. The SMZ law, Rules for Forest Management, and applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. The Montana BMP audit process has been used to evaluate the application and effectiveness of forest-management BMPs since 1990; this process has also been used to evaluate the application and effectiveness of the SMZ Law since 1996. During that time, evaluation of ground-based skidding practices near riparian areas has been rated 92-percent effective, and these same practices have been found effective over 99 percent of the time from 1998 to present (*DNRC 1990* through *2006*). Since 1996, effectiveness of the SMZ width has been rated over 99 percent (*DNRC 1990* through *2004*). As a result, with the application of BMPs and the SMZ Law, proposed activities are expected to have a low risk of low impacts to sediment delivery. Action Alternative C proposes no timber harvesting within an SMZ or RMZ.

- ***Direct and Indirect Effects of Action Alternative D to Sediment Delivery***

Several stream crossings would be replaced as described in *DIRECT AND INDIRECT EFFECTS TO SEDIMENT DELIVERY COMMON TO ACTION ALTERNATIVES B, C AND D*, and erosion control and BMPs would be improved on up to 71 miles of existing road. This work would:

- reduce the estimated sediment load to South Woodward Creek by approximately 3.4 tons of sediment per year;
- reduce the estimated sediment load to Woodward Creek by approximately 1.6 ton per year; and
- reduce the estimated sediment load to Whitetail Creek by approximately 4.6 tons per year.

These projected sediment reductions are net values for each watershed. These values include the projected increases in sediment delivery from new stream crossings and new road construction, as well as projected sediment reductions from BMP improvements and road and stream-crossing improvement activities. A more-detailed summary of sediment delivery estimates is found in *TABLE H-3* (*4, 5*) – *SOUTH WOODWARD* (*WOODWARD, WHITETAIL*) *DELIVERY*.

Action Alternative D would also construct approximately 11.2 miles of new road to access proposed harvest units. The impacts of proposed new roads are primarily associated with new stream crossings. These impacts are discussed below and in *TABLE H-3* (*4,5*) – *SOUTH WOODWARD* (*WOODWARD, WHITETAIL*) *DELIVERY*. The remainder of the impacts of new road construction is related to the risk of erosion resulting from exposure of bare soil. The risk of sediment delivery from new permanent roads is low where these roads are located away from stream crossings. As cut slopes and fill slopes revegetate, this risk would decrease. The installation of surface drainage and implementation of other BMPs and Forest Management Rules would further reduce the risk of erosion or sediment delivery from new roads.

Action Alternative D proposes 1 new stream crossing, which would be installed in the upper reaches of Woodward Creek in Section 16 of the proposed project area. This crossing would be located in a deep "V"-shaped valley with steep sideslopes (60 to 80 percent). Due to the steepness of the sideslopes coming into the proposed crossing, cutslopes would be much higher than those on standard stream crossings. This type of road construction required on the road approaches does not use fill material; all material cut in order to construct these portions of road would be hauled away in trucks, so the only risk to assess at this site is associated with the cutslopes and road travel surface. This increase in cutslope height would increase the risk of cutslope material being eroded and routed to streams. The soil parent material is glacial till at these sites, which also may increase the risk of material either being eroded or having small cutslope failures fill and plug the road ditches. With all applicable BMPs in place at this site, the risk of erosion problems sending sediment to the stream is moderate, which means there is approximately a 50-percent chance that impacts may occur as a result of construction. Potential impacts to water quality are moderate. Therefore, if impacts would occur, they would be detectable or measurable, and these impacts may or may not be detrimental to downstream beneficial uses. If a culvert is used as a crossing structure at this site, fill depths in this type of draw are typically deep and can generate large areas of bare fill material. Fill slopes like these present a moderate risk of moderate impacts for several years until the site is vegetated. Once vegetated, the fill would present a low risk of low impacts to the stream. If a bridge is installed at this site, the fill volumes and bare soil area would be greatly reduced. A bridge would carry a moderate risk of sediment delivery, but with reduced bare soil for erosion the impacts would be low.

This alternative would have a low risk of sediment delivery to streams as a result of proposed timber-harvesting activities. The SMZ law, Rules for Forest Management, and applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. The Montana BMP audit process has been used to evaluate the application and effectiveness of forest-management BMPs since 1990; this same process has also been used to evaluate the application and effectiveness of the SMZ Law since 1996. During that time, evaluation of ground-based-skidding practices near riparian areas has been rated 92-percent effective, and these same practices have been found effective over 99 percent of the time from 1998 to present (*DNRC 1990* through *2006*). Since 1996, effectiveness of the SMZ width has been rated over 99 percent (*DNRC 1990* through *2004*). As a result, with the application of BMPs and the SMZ Law, proposed activities are expected to have a low risk of low impacts to sediment delivery. Action Alternative D proposes no timber harvesting within an SMZ or RMZ.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Sediment Delivery***

The cumulative effects would be very similar to those described in the *EXISTING ENVIRONMENT* earlier in this analysis. All existing sources of sediment would continue to recover or degrade as dictated by natural and preexisting conditions until a source of funding became available to repair them. Sediment loads would remain at or near present levels.

- ***Cumulative Effects of Action Alternative B to Sediment Delivery***

Cumulative effects to sediment delivery would be primarily related to roadwork and stream-crossing replacements. Sediment generated from the replacement of existing culverts would increase the total sediment load in streams flowing through the project area and proposed haul routes for the duration of the activities. These increases would not exceed any State water-quality laws and would follow all applicable recommendations given in the 124 and 318 permits. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 23.6 tons of sediment per year to approximately 19.4 tons of sediment per year in South Woodward Creek, from 3.5 tons per year to approximately 2.1 tons per year in Woodward Creek, and from 5.9 tons per year to 1.4 tons per year in Whitetail Creek. These values include projected increases from new road and stream-crossing construction, potential increases from the replacement of existing stream-crossing structures, and projected reductions in sediment delivery from upgrading surface drainage, erosion control, and BMPs on existing roads. A summary of sediment-delivery estimates is found in *TABLE H-3* (*4,5*) *– SOUTH WOODWARD* (*WOODWARD, WHITETAIL*) *DELIVERY* at the end of the *SEDIMENT DELIVERY* effects. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as worksites are closed and bare soil revegetates and stabilizes. Over the long term, cumulative sediment loads would be reduced due to better design on the crossings. The improved design would reduce the risk of failure of the structures, which would reduce the risk of sediment delivery to downstream beneficial uses.

The construction of new roads and stream crossings and the installation and improvement of erosion-control and surface-drainage features on existing roads associated with Action Alternative B would also affect the cumulative sediment delivery to South Woodward, Woodward, and Whitetail creeks as described above (*Burroughs and King 1989*). In the short term, new road construction and the installation and improvement of surface drainage features would expose bare soil, which would increase the risk of short-term sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would minimize the risk of potential short-term sediment loading to downstream waters. Over the long term, cumulative sediment delivery to South Woodward, Woodward, and Whitetail creeks are projected to be lower than existing conditions. Projected increases in sediment delivery from new road and stream-crossing construction would be far less than the sediment-delivery decreases expected with the installation of more effective surface-drainage and erosion-control features on the existing road system. The net long-term effect to sediment delivery from this alternative is expected to be a cumulative decrease from preproject levels.

Action Alternative B would have an overall low risk of adverse cumulative impacts to sediment yield in project-area watersheds and presents a low risk to adversely affect downstream beneficial uses. Although risk is elevated at site-specific locations, overall risk of adverse cumulative effects to sediment loading is low. Implementation of BMPs, the SMZ Law, and Forest Management Rules would ensure low risk of increased sediment delivery, and improvements to the existing road system would substantially reduce cumulative levels of sedimentation compared to current levels. All activities would comply with applicable laws, rules, and regulations.

- ***Cumulative Effects of Action Alternative C to Sediment Delivery***

Cumulative effects to sediment delivery would be primarily related to roadwork and stream-crossing replacements. Sediment generated from the replacement of existing culverts would increase the total sediment load in streams flowing through the project area and proposed haul routes for the duration of the activities. These increases would not exceed any State water-quality laws and would follow all applicable recommendations given in the 124 and 318 permits. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 3.5 tons per year to approximately 1.9 tons per year in Woodward Creek and from 5.9 tons per year to 1.2 tons per year in Whitetail Creek. These values include projected increases from new road construction, potential increases from the replacement of existing stream-crossing structures, and the projected reductions in sediment delivery from upgrading surface drainage, erosion control, and BMPs on existing roads. No changes are projected in the South Woodward Creek watershed with this alternative because none of the roads are proposed for use, construction, or log hauling with this alternative. A summary of sediment-delivery estimates is found in *TABLE H-3* (*4,5*) *– SOUTH WOODWARD* (*WOODWARD,* *WHITETAIL*) *DELIVERY* at the end of the *SEDIMENT DELIVERY* effects. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as worksites are closed and bare soil revegetates and stabilizes. Over the long term, cumulative sediment loads would be reduced due to better design on the crossings. The improved design would reduce the risk of failure of the structures, which would reduce the risk of sediment delivery to Swan River and other downstream waters.

The construction of new roads and stream crossings and installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to Woodward and Whitetail creeks as described above. In the short term, new road construction and the installation and improvement of surface drainage features would expose bare soil, which would increase the risk of short-term sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would minimize the risk of potential short-term sediment loading to downstream waters. Over the long term, cumulative sediment delivery to Woodward and Whitetail creeks are projected to be lower than existing conditions. Projected increases in sediment delivery from new road construction would be far less than the sediment-delivery decreases expected with the installation of more effective surface-drainage and erosion-control features on the existing road system. The net long-term effect to sediment delivery from this alternative to downstream beneficial uses is expected to be a cumulative decrease from preproject levels.

Action Alternative C would have a low risk of adverse cumulative impacts to sediment yield in project-area watersheds and presents a low risk to adversely affect downstream beneficial uses. Implementation of BMPs, the SMZ Law, and Forest Management Rules would ensure low risk of increased sediment delivery, and improvements to the existing road system would substantially reduce cumulative levels of sedimentation compared to current levels. All activities would comply with applicable laws, rules, and regulations.

- ***Cumulative Effects of Action Alternative D to Sediment Delivery***

Cumulative effects to sediment delivery would be primarily related to roadwork and stream-crossing replacements. Sediment generated from the replacement of existing culverts would increase the total sediment load in streams flowing through the project area and proposed haul routes for the duration of activity. These increases would not exceed any State water-quality laws and would follow all applicable recommendations given in the 124 and 318 permits. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 23.6 tons of sediment per year to approximately 20.2 tons of sediment per year in South Woodward Creek, from 3.5 tons per year to approximately 1.9 tons per year in Woodward Creek, and from 5.9 tons per year to 1.3 tons per year in Whitetail Creek. These values include projected increases from new road and stream-crossing construction, potential increases from the replacement of existing stream-crossing structures, and the projected reductions in sediment delivery from upgrading surface drainage, erosion control, and BMPs on existing roads. A summary of sediment-delivery estimates is found in *TABLE H-3* (*4,5*) – *SOUTH WOODWARD* (*WOODWARD, WHITETAIL*) *DELIVERY* at the end of the *SEDIMENT DELIVERY* effects. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as worksites are closed and bare soil revegetates and stabilizes. Over the long term, cumulative sediment loads would be reduced due to better design on the crossings. The improved design would reduce the risk of failure of the structures, which would reduce the risk of sediment delivery to Swan River and other downstream waters.

The construction of new roads and stream crossings and installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to South Woodward, Woodward, and Whitetail creeks as described above. In the short term, new road construction and the installation and improvement of surface drainage features would expose bare soil. This would increase the risk of short-term sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would minimize the risk of potential short-term sediment loading to downstream waters. Over the long term, cumulative sediment delivery to South Woodward, Woodward, and Whitetail creeks are projected to be lower than existing conditions. Projected increases in sediment delivery from new road and stream-crossing construction would be far less than the sediment-delivery decreases expected with the installation of more effective surface-drainage and erosion-control features on the existing road system. The net long-term effect to sediment delivery from this alternative to downstream beneficial uses is expected to be a cumulative decrease from preproject levels.

Action Alternative D would have a low risk of adverse cumulative impacts to sediment yield in project-area watersheds and presents a low risk to adversely affect downstream beneficial uses. Implementation of BMPs, the SMZ Law, and Forest Management Rules would ensure low risk of increased sediment delivery, and improvements to the existing road system would substantially reduce cumulative levels of sedimentation compared to current levels. All activities would comply with applicable laws, rules, and regulations.

WATER YIELD

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Water Yield***

No direct or indirect effects on water yield would be expected. Water quantity would not be changed from present levels and the harvest units would continue to return to fully forested conditions as areas of historic timber-harvests regenerate.

- ***Direct and Indirect Effects Common to Action Alternatives B, C, and D***

The annual water yield in the unnamed tributary to Swan River located between the Whitetail Creek and Woodward Creek watersheds would increase over current levels. These levels are expected to have a low risk of moderate impacts to these stream channels due to high channel stability, the stable, spring-fed nature of the watershed, and the low elevation and low precipitation characteristics of the streams. Peak flow volume and duration may be slightly elevated, and the timing of peak flows may be slightly earlier as a result of the proposed harvesting activities. These changes have a low risk of low impacts to the stream channels in the unnamed tributary to Swan River.

- ***Direct and Indirect Effects of Action Alternative B to Water Yield***

The annual water yield in the South Woodward Creek watershed would increase by an estimated 0.6 percent over the current level. The annual water yield in the Woodward Creek watershed would increase by an estimated 2.0 percent over the current level. The annual water yield in the Whitetail Creek watershed would increase by an estimated 4.6 percent over the current level. The annual water yield in the East Porcupine Creek watershed would increase by an estimated 1.7 percent over the current level. These levels of projected water-yield increase are incremental values that refer only to water yield generated by this action alternative and do not include increases in water yield from past activities. The cumulative water-yield increase will assess the impacts of the proposed action alternative when added to the impacts of past and planned future activities; this will be discussed in *CUMULATIVE EFFECTS* further on in this analysis. These levels of water-yield increases would produce a low risk of creating unstable channels in any of the project-area streams. Peak flow volume and duration may be elevated, and the timing of peak flows may be slightly earlier as a result of the proposed harvesting activities. These changes have a low risk of low impacts to the stream channels in each of the watersheds listed above.

- ***Direct and Indirect Effects of Action Alternative C to Water Yield***

The annual water yield in the South Woodward Creek watershed would be unchanged from the current level since no harvesting or road construction activites are planned in this watershed. The annual water yield in the Woodward Creek watershed would increase by an estimated 0.6 percent over the current level. The annual water yield in the Whitetail Creek watershed would increase by an estimated 6.5 percent over the current level. The annual water yield in the East Porcupine Creek watershed would increase by an estimated 3.5 percent over the current level. These levels of projected water-yield increase are incremental values that refer only to water yield generated by this action alternative and do not include water yield increases from past activities. The cumulative water-yield increase will assess the impacts of the proposed action alternative when added to the impacts of past and planned future activities; this will be discussed in *CUMULATIVE EFFECTS* further on in this analysis. These levels of water-yield increases would produce a low risk of creating unstable channels in any of the project-area streams. Peak flow volume and duration may be elevated, and the timing of peak flows may be slightly earlier as a result of the proposed harvesting activities. These changes have a low risk of low impacts to the stream channels in each of the watersheds listed above.

- ***Direct and Indirect Effects of Action Alternative D to Water Yield***

The annual water yield in the South Woodward Creek watershed would be unchanged from the current level since no harvesting or road construction activity is planned in this watershed. The annual water yield in the Woodward Creek watershed would increase by an estimated 2.5 percent over the current level. The annual water yield in the Whitetail Creek watershed would increase by an estimated 4.0 percent over the current level. The annual water yield in the East Porcupine Creek watershed would increase by an estimated less than 0.1 percent over the current level. These levels of projected water-yield increase are incremental values that refer only to water yield generated by this action alternative and do not include increases in water yield from past activities. The cumulative water-yield increase will assess the impacts of the proposed action alternative when added to the impacts of past and planned future activities; this will be discussed in *CUMULATIVE EFFECTS* further on in this analysis. These levels of water-yield increases would produce a low risk of creating unstable channels in any of the project-area streams. Peak-flow volume and duration may be elevated, and the timing of peak flows may be slightly earlier as a result of the proposed harvesting activities. These changes have a low risk of low impacts to the stream channels in each of the watersheds listed above.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A on Water Yield***

No cumulative effects on water yield are expected. Existing harvest units would continue to revegetate and move closer to premanagement levels of water use and snowpack distribution.

- ***Cumulative Effects Common to Action Alternatives B, C, and D***

The removal of trees, combined with past and foreseeable future activities would increase water yield in the unnamed tributary to Swan River located between the Whitetail Creek and Woodward Creek watersheds. These levels are expected to have a low risk of moderate impacts to these stream channels due to:

- high channel stability;
- the stable, spring-fed nature of the watershed, and
- the low elevation and low precipitation characteristics of the streams.

Peak flow volume and duration may be slightly elevated, and the timing of peak flows may be slightly earlier as a result of the proposed harvesting activities. These changes have a low risk of low impacts to the stream channels in the unnamed tributary to Swan River.

- ***Cumulative Effects of Action Alternative B on Water Yield***

The removal of trees proposed in Action Alternative B would increase the water yield in the South Woodward Creek watershed from its current level of approximately 8.3 percent over a fully forested condition to an estimated 8.9 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activites, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the South Woodward Creek watershed. The water-yield increase expected from this alternative leaves the watershed well below the established threshold of concern reported in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in South Woodward Creek or its tributaries.

The removal of trees proposed in Action Alternative B would increase the water yield in the Woodward Creek watershed from its current level of approximately 7.2 percent over a fully forested condition to an estimated 9.2 percent. This water-yield increase and its associated ECA level includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Woodward Creek watershed. The water-yield increase expected from Action Alternative B leaves the watershed below the established threshold of concern reported in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Woodward Creek or its tributaries.

The removal of trees proposed in Action Alternative B would increase the water yield in the Whitetail Creek watershed from its current level of approximately 7.4 percent over a fully forested condition to an estimated 12.0 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activites, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Whitetail Creek watershed. The water-yield increase expected from Action Alternative B leaves the watershed at its established threshold of concern reported in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low to moderate risk of creating unstable channels in Whitetail Creek or its tributaries. The threshold of concern is a level of activity around which impacts may become visible or measurable. Since the threshold was set with a low degree of risk, and the channel stability is good in Whitetail Creek, to begin to see or measure impacts to water yield at this level of vegetative removal is unlikely, but possible.

The removal of trees proposed in Action Alternative B would increase the water yield in the East Porcupine Creek watershed from its current level of approximately 6.6 percent over a fully forested condition to an estimated 8.3 percent. This water-yield increase and its associated ECA level includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the East Porcupine Creek watershed. The water-yield increase expected from Action Alternative B leaves the watershed below the established threshold of concern reported in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in East Porcupine Creek or its tributaries.

Action Alternative B is expected to have a low risk of cumulative impacts to water yield as a result of the proposed timber harvesting. A summary of the anticipated water-yield impacts of Action Alternative B to the South Woodward, Woodward, Whitetail, and East Porcupine creek drainages is found in *TABLE D-6* (*7, 8, 9*) – *SOUTH WOODWARD WATER YIELD* (*WOODWARD, WHITETAIL, EAST PORCUPINE*).

- ***Cumulative Effects of Action Alternative C on Water Yield***

The removal of trees proposed in Action Alternative C would not change the water yield in the South Woodward Creek watershed from its current level of approximately 8.3 percent over a fully forested condition. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the South Woodward Creek watershed. The water-yield increase expected from this alternative leaves the watershed well below the established threshold of concern reported in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in South Woodward Creek or its tributaries.

The removal of trees proposed in Action Alternative C would increase the water yield in the Woodward Creek watershed from its current level of approximately 7.2 percent over a fully forested condition to an estimated 7.8 percent. This water-yield increase and its associated ECA level includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Woodward Creek watershed. The water-yield increase expected from Action Alternative C leaves the watershed below the established threshold of concern reported in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Woodward Creek or its tributaries.

The removal of trees proposed in Action Alternative C would increase the water yield in the Whitetail Creek watershed from its current level of approximately 7.4 percent over a fully forested condition to an estimated 13.9 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Whitetail Creek watershed. The water-yield increase expected from Action Alternative C leaves the watershed slightly above the established threshold of concern. It is possible that increases in flow could be observed through the implementation of Action Alternative C. Changes in channel conditions are unlikely, but could occur in individual reaches that have lower channel stability. These changes could include increased streambank erosion, channel down-cutting, and migration of channels away from current locations. Should in-channel erosion occur, deposition of bed and bank material could be deposited in the flatter, gentler reaches. These projections are possible but unlikely given the good channel-stability ratings of Whitetail Creek, and Action Alternative C would most likely not have measurable impacts to the stream channel. However, the estimated water-yield increases would leave a low to moderate risk of the described potential negative impacts in the less stable reaches and in isolated instances. The predicted water yield increases in Whitetail Creek are projected to decrease to below threshold levels in less than 10 years due to vegetative recovery of past harvesting activities.

The removal of trees proposed in Action Alternative C would increase the water yield in the East Porcupine Creek watershed from its current level of approximately 6.6 percent over a fully forested condition to an estimated 10.1 percent. This water-yield increase and its associated ECA level includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the East Porcupine Creek watershed. The water-yield increase expected from Action Alternative C leaves the watershed below the established threshold of concern reported in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in East Porcupine Creek or its tributaries.

Action Alternative C is expected to have a low risk of cumulative impacts to water yield as a result of the proposed timber harvesting in Woodward, South Woodward , and East Porcupine creeks. Action Alternative C is expected to have a moderate risk of cumulative impacts to water yield as a result of the proposed timber harvesting in Whitetail Creek. A summary of the anticipated water-yield impacts of Action Alternative C to the South Woodward, Woodward, Whitetail, and East Porcupine creek drainages is found in *TABLE D-6* (*7*, *8*, *9*) – *SOUTH WOODWARD WATER YIELD* (*WOODWARD, WHITETAIL, EAST PORCUPINE*).

- ***Cumulative Effects of Action Alternative D on Water Yield***

The removal of trees proposed in Action Alternative D would not change the water yield in the South Woodward Creek watershed from its current level of approximately 8.3 percent over a fully forested condition. This water-yield increase, and its associated ECA level, includes the impacts of all past management activites, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the South Woodward Creek watershed. The water-yield increase expected from this alternative leaves the watershed well below the established threshold of concern reported in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in South Woodward Creek or its tributaries.

The removal of trees proposed in Action Alternative D would increase the water yield in the Woodward Creek watershed from its current level of approximately 7.2

percent over a fully forested condition to an estimated 9.7 percent. This water-yield increase and its associated ECA level includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Woodward Creek watershed. The water-yield increase expected from Action Alternative D leaves the watershed below the established threshold of concern reported in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Woodward Creek or its tributaries.

The removal of trees proposed in Action Alternative D would increase the water yield in the Whitetail Creek watershed from its current level of approximately 7.4 percent over a fully forested condition to an estimated 11.4 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Whitetail Creek watershed. The water-yield increase expected from Action Alternative D leaves the watershed below the established threshold of concern reported in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Whitetail Creek or its tributaries.

The removal of trees proposed in Action Alternative D would increase the water yield in the East Porcupine Creek watershed from its current level of approximately 6.6 percent over a fully forested condition to an estimated 8.3 percent. This water-yield increase and its associated ECA level includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the East Porcupine Creek watershed. The water-yield increase expected from Action Alternative D leaves the watershed below the established threshold of concern reported in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in East Porcupine Creek or its tributaries.

Action Alternative D is expected to have a low risk of cumulative impacts to water yield as a result of the proposed timber harvesting. A summary of the anticipated water-yield impacts of Action Alternative B to the South Woodward, Woodward, Whitetail and East Porcupine creek drainages is found in *TABLE D-6* (*7*, *8*, *9*) – *SOUTH WOODWARD WATER YIELD* (*WOODWARD, WHITETAIL, EAST PORCUPINE*).

TABLE H-6 – SOUTH WOODWARD WATER YIELD. ECA and percent water-yield increase results for the South Woodward Creek watershed.

	ALTERNATIVE			
	A	B	C	D
Allowable water-yield increase (percent)	12	12	12	12
Percent water-yield increase	8.3	8.9	8.3	8.3
Acres harvested[1]	0	281	0	0
Miles of new road[1]	0	2.6	0	0
ECA generated	0	207	0	0
Total ECA	1,772	1,979	1,772	1,772
Allowable ECA	2,758	2,758	2,758	2,758

Table H–7 - WOODWARD WATER YIELD. ECA and percent water-yield increase results for the Woodward Creek watershed.

	ALTERNATIVE			
	A	B	C	D
Allowable water-yield increase (percent)	12	12	12	12
Percent water-yield increase	7.2	9.2	7.8	9.7
Acres harvested[1]	0	331	147	434
Miles of new road[1]	0	3.8	0.7	4.5
ECA generated	0	279	129	368
Total ECA	1,150	1,429	1,279	1,518
Allowable ECA	2,038	2,038	2,038	2,038

TABLE H–8 – WHITETAIL WATER YIELD. ECA and percent water-yield increase results for the Whitetail Creek watershed.

	ALTERNATIVE			
	A	B	C	D
Allowable water-yield increase (percent)	12	12	12	12
Percent water-yield increase	7.4	12.0	13.9	11.4
Acres harvested[1]	0	633	1,015	613
Miles of new road[1]	0	6.3	7.7	5.5
ECA generated	0	563	500	368
Total ECA	756	1,348	1,681	1,308
Allowable ECA	1,517	1,517	1,517	1,517

TABLE H–9 – EAST PORCUPINE WATER YIELD. ECA and percent water-yield increase results for the East Porcupine Creek watershed.

	ALTERNATIVE			
	A	**B**	**C**	**D**
Allowable water-yield increase (percent)	15	15	15	15
Percent water-yield increase	6.6	8.3	10.1	6.6
Acres harvested[1]	0	135	264	0
Miles of new road[1]	0	0.8	0.5	0.5
ECA generated	0	119	204	1
Total ECA	340	459	544	341
Allowable ECA	908	908	908	908

[1] *Does not include acres or road segments located outside of watershed boundary.*

INTRODUCTION

The purpose of this analysis is to assess potential impacts to fisheries in the project area (see *CHAPTER 1 – PURPOSE AND NEED*) as a result of implementing any one of the project alternatives.

The project area lies entirely in the Swan River drainage (*Fifth Code HUC 17010211030*). Up to 1,563 acres of total harvest area and 14.0 miles of new road construction are proposed in the project area.

Native cold-water fish species in the project area include:

- bull trout (*Salvelinus confluentus*),
- westslope cutthroat trout (*Oncorhynchus clarki lewisi*),
- slimy sculpin (*Cottus cognatus*),
- largescale sucker (*Catostomus macrocheilus*),
- longnose sucker (*Catostomus catostomus*),
- longnose dace (*Rhinichthys cataractae*),
- mountain whitefish (*Prosopium williamsoni*),
- northern pike minnow (*Ptychocheilus oregonensis*),
- peamouth (*Mylocheilus caurinus*), and
- redside shiner (*Richardsonius balteatus*).

The 3 nonnative species known to persist within the specific project area are:

- eastern brook trout (*Salvelinus fontinalis*),
- rainbow trout (*Oncorhynchus mykiss*), and
- kokanee (*Oncorhynchus nerka*).

The remainder of this introduction will focus on a brief review of the life history and ecology of bull trout and westslope cutthroat trout since these species will be the primary focus of the following effects analysis (see *ANALYSIS METHODS*).

Both bull trout and westslope cutthroat trout exhibit resident, fluvial, and adfluvial life forms. Resident life forms spend their juvenile and adult life in natal or nearby low-order tributaries. Fluvial and adfluvial life forms generally leave their natal streams within 1 to 3 years of emergence (*Shepard et al 1984, Fraley and Shepard 1989*) to mature in downstream river and lake systems, respectively, and then return again to headwater or upstream reaches to spawn. Fluvial and adfluvial life forms of bull trout and westslope cutthroat trout are typically larger than resident fish, and bull trout have been observed returning to upstream reaches during successive or alternating years to spawn (*Fraley and Shepard 1989*). Overall, the life forms and stages of bull trout and westslope cutthroat trout have evolved to exist in sympatry (*Nakano et al 1992, Pratt 1984, Shepard et al 1984*).

Fluvial and adfluvial bull trout generally mature at ages 5 to 6 years, begin upstream spawning migrations in April, and spawn between September and October in response to a temperature regime decline below 9 to 10 degrees Celsius (*Fraley and Shepard 1989*). Spawning adult bull trout are known to construct redds in close association with upwelling groundwater and proximity to overhanging or instream cover (*Fraley and Shepard 1989*). Naturally occurring stream-temperature regimes and substrate compositions having low levels of fine material are closely related to bull trout embryo and juvenile survival (*MBTSG 1998, Weaver and Fraley 1991, Pratt 1984*).

Bull trout have been found inhabiting streams with wetted widths as low as 1.0 meter and gradients as high as 15.6 percent (*Rich et al 2003*), while observed average measures have ranged from 3.1 to 12.4 meters for wetted width and 1.6 to 5.6 percent for stream gradient (*Dunham and Chandler 2001, Rich et al 2003*). Bull trout appear to prefer average maximum seasonal stream temperatures ranging from approximately 14.0 to 16.0 degrees Celsius (*Rieman and Chandler 1999, Sauter et al 2001, Gamett 2002, Rich et al 2003*).

Resident westslope cutthroat trout have been observed maturing at ages 3 to 5 years (*Downs et al 1997*), and all life forms are known to spawn during May through June (*Shepard et al 1984*). Naturally occurring stream-temperature regimes and substrate compositions having low levels of fine material are closely related to westslope cutthroat trout embryo and juvenile survival (*Pratt 1984*).

Westslope cutthroat trout were found throughout the watersheds of their historic range, including small, first-order, headwater stream reaches (*Behnke 1992, McIntyre and Rieman 1995*). A summary of scientific literature on westslope cutthroat trout (*McIntyre and Rieman 1995*) indicates the subspecies prefers stream temperatures less than 16 degrees Celsius and can be found in streams with gradients up to 27 percent.

RELEVANT AGREEMENTS, LAWS, PLANS, RULES AND REGULATIONS

The USFWS has listed bull trout as "threatened" under the Endangered Species Act. Both bull trout and westslope cutthroat trout are listed as Class-A Montana Animal Species of Concern. A Class-A designation is defined as a species or subspecies that has limited numbers and/or habitats both in Montana and elsewhere in North America and elimination from Montana would be a significant loss to the gene pool of the species or subspecies (*DFWP, MNHP*, and *Montana Chapter American Fisheries Society Rankings*). DNRC has also identified bull trout and westslope cutthroat trout as sensitive species (*ARM 36.11.436*).

DNRC is a cooperator and signatory to the following relevant agreements: *Restoration Plan for Bull Trout in the Clark Fork River Basin and the Kootenai River Basin, Montana (2000)*, *Memorandum of Understanding (2005) for the Swan Valley Bull Trout Work Group*, and *Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout and Yellowstone Cutthroat Trout in Montana (2007)*. All 3 agreements contain land-management conservation strategies or action items utilized by DNRC as decisionmaking tools.

Neither Swan River nor any waterbodies contained in the fisheries analysis areas are individually identified on the *2006 Montana 303(d)* lists as impaired streams, although a TMDL analysis completed for Swan Lake includes Swan River and its tributaries (see *HYDROLOGY ANALYSIS*).

Swan River and all waterbodies contained in the fisheries analysis areas are classified as B-1 in the *Montana Surface Water Quality Standards (ARM 17.30.608[b][i])*. The B-1 classification is for multiple beneficial use waters, including the growth and propagation of cold-water fisheries and associated aquatic life. Among other criteria for B-1 waters, a 1-degree Fahrenheit maximum increase above naturally occurring water temperature is allowed within the range of 32 to 66 degrees Fahrenheit (0 to 18.9 degrees Celsius), and no increases are allowed above naturally occurring concentrations of sediment or suspended sediment that will harm or prove detrimental to fish or wildlife. In regard to sediment, naturally occurring includes conditions or materials present from runoff or percolation from developed land where all reasonable land, soil, and water conservation practices have been applied (*ARM 17.30.603 [19]*). Reasonable practices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses (*ARM 17.30.603[24]*). The State has adopted BMPs through its *Nonpoint Source Management Plan* as the principle means of controlling nonpoint source pollution from silvicultural activities (*Thomas et al 1990*).

Fisheries-specific forest management ARMs (*36.11.425* and *36.11.427*) and the SMZ law and rules would be implemented as part of any action alternative.

ISSUES AND MEASUREMENT CRITERIA

Issues, in respect to this environmental analysis, are not specifically defined by either the *Montana Environmental Policy Act* or *Council on Environmental Quality*. For the purposes of this environmental analysis, issues will be considered actual or perceived effects, risks, or hazards as a result of the proposed alternatives.

Fifteen detailed written concerns and issues regarding fisheries resources were raised through public participation during the scoping process. These concerns and issues are contained in a separate document (*2008_0418_WhitePorcEIS_IssueStatements.xls*) that can be found in the project file. Each detailed concern and issue is identified and followed with a statement describing how the concern or issue will be addressed by this analysis.

The broad issues raised both internally and through public comment during the scoping process are that the proposed actions may adversely affect fisheries populations and fisheries habitat features, including flow regime, sediment, channel forms, riparian condition, large woody debris, stream temperature, macroinvertebrate richness, and connectivity, in fish-bearing streams within the project area. The following brief rationales describe why these broad issues are important fisheries resource concerns:

- POPULATION – provides the status and distribution of fish species in the project area.
- FLOW REGIME – affects species migration, spawning, and embryo survival and is a direct contributor to the function of other features such as sediment, channel forms, stream temperature, and macroinvertebrate richness.
- SEDIMENT – is a major habitat feature affecting fish embryo survival, the quality and quantity of channel form features, and macroinvertebrate richness.
- CHANNEL FORMS – describe the quantities of various fish habitat types.
- RIPARIAN CONDITION – is the primary terrestrial feature affecting large woody debris and stream shading, which indirectly affects both channel form features and stream temperature.
- LARGE WOODY DEBRIS – is a major contributor to the quality and quantity of channel form features.
- STREAM TEMPERATURE – directly affects the survivability, metabolism, dynamics, and distribution of fish species.
- MACROINVERTEBRATE RICHNESS – is an indicator of water quality, nutrients, and stream productivity.
- CONNECTIVITY – describes the potential for fish to migrate within and between available habitats.

Depending on the type and extent of the proposed actions, these issues will (or will not) be addressed separately for each analysis area under the *EXISTING ENVIRONMENT* and *ENVIRONMENTAL EFFECTS* sections.

Issue variables, normal effect mechanisms, potential effect mechanisms, and measurement criteria establish the foundation of analysis for each of the broad fisheries issues. These 4 descriptors are described below (*TABLE F-1 – ISSUE VARIABLES, NORMAL EFFECT MECHANISM, POTENTIAL EFFECT MECHANISM, AND MEASUREMENT CRITERIA*) for each of the broad fisheries issues. The broad issues include those variables that have potentially measurable or detectable criteria and are expected to support the development of meaningful effects analyses.

For the purposes of this analysis, issue variables are the primary factors that contribute to a broad environmental issue. Normal effect mechanisms describe the typical physical or biological processes that determine how issue variables are expressed in the environment. Potential effect mechanisms describe the processes through which the proposed actions may affect normal effect mechanisms and, consequently, issue variables.

TABLE F-1 – ISSUE VARIABLES, NORMAL EFFECT MECHANISM, POTENTIAL EFFECT MECHANISM, AND MEASUREMENT CRITERIA

ISSUE	VARIABLE	NORMAL EFFECT MECHANISM	POTENTIAL ACTION EFFECT MECHANISM	MEASUREMENT CRITERIA
Population	Species presence or absence	Historic range of native species, range of nonnative species, species status	Species introduction, suppression, or removal	Species presence or absence
	Genetics	Species migration, species isolation	Species introduction, suppression, or removal	Pure genetics, genetic introgression, or hybridization
Flow regime	Gross annual flow volume	Precipitation + ECA[1] + watershed area + elevation + climate	Increase in ECA[1]	Annual water yield[2]
	Peak seasonal flow volume	Precipitation + ECA[1] + watershed area + elevation + climate	Increase in ECA[1]	Peak seasonal flow volume
	Peak seasonal flow time	Precipitation + ECA[1] + watershed area + elevation + climate	Increase in ECA[1]	Peak seasonal flow time
	Peak seasonal flow duration	Precipitation + ECA[1] + watershed area + elevation + climate	Increase in ECA[1]	Peak seasonal flow duration

TABLE F-1 – ISSUE VARIABLES, NORMAL EFFECT MECHANISM, POTENTIAL EFFECT MECHANISM AND MEASUREMENT CRITERIA (continued)

Sediment	Fine sediment	**Flow regime** + sediment budget	Sedimentation from: 1) road-stream crossing structure, 2) adjacent roads, 3) Riparian Management Zone (RMZ) disturbance	Percent fine sediment
	Embeddedness (*Sylte and Fischenich 2002*)	**Flow regime** + sediment budget	Sedimentation from: 1) road-stream crossing structure, 2) adjacent roads, 3) RMZ disturbance	Substrate score (*Weaver and Fraley 1991 citing others*)
	Surface substrate sizeclass distribution	**Flow regime** + sediment budget	Sedimentation from: 1) road-stream crossing structure, 2) adjacent roads, 3) RMZ disturbance	Relative percent of size classes per *Rosgen* channel type (*Rosgen 1996*)
Channel forms	Channel type	**Flow regime** + **sediment** + stream gradient + stream confinement	Change in **flow regime** and/ or **sediment**	Rosgen (1996), Montgomery and Buffington channel types (*Montgomery and Buffington 1997*)
	Fast/slow fish habitat frequency	**Flow regime** + **sediment** + **large woody debris** + stream gradient + stream confinement	Change in **flow regime**, **sediment**, and/or **large woody debris** (if applicable)	Percent of slow habitats per stream reach
	Fast/slow fish habitat volume	**Flow regime** + **sediment** + **large woody debris** + stream gradient + stream confinement	Change in **flow regime**, **sediment**, and/or **large woody debris** (if applicable)	Total volume of slow habitats per stream reach
	Channel bank stability (*Overton et al 1997 citing others*)	**Flow regime** + **sediment** + stream gradient + stream confinement	Change in **flow regime** and/ or **sediment**	Percent of stable channel bank per stream reach

FISHERIES ANALYSIS

TABLE F-1 – ISSUE VARIABLES, NORMAL EFFECT MECHANISM, POTENTIAL EFFECT MECHANISM AND MEASUREMENT CRITERIA (continued)

ISSUE	VARIABLE	NORMAL EFFECT MECHANISM	POTENTIAL ACTION EFFECT MECHANISM	MEASUREMENT CRITERIA
Riparian condition	Riparian stand characteristics	Precipitation + physiographic location + elevation + soils/geology	RMZ timber harvest	Average trees per acre, average quadratic mean diameter, average basal area per acre, average height of site index trees at 100 years
	Riparian habitat type (climax)	Precipitation + physiographic location + elevation + soils/geology	RMZ timber harvest	Riparian habitat type (climax)
	Riparian habitat type (regional functionality)	Precipitation + physiographic location + elevation + soils/geology	RMZ timber harvest	Riparian habitat type (regional functionality)
	Rate of riparian tree blowdown	Precipitation + physiographic location + elevation + soils/geology + wind events	RMZ timber harvest	Average rate of riparian tree blowdown
	Stream shading	Precipitation + physiographic location + elevation + soils/geology	RMZ timber harvest	Average angular canopy density for July and August
Large woody debris	In-stream large woody debris frequency	**Riparian condition**	RMZ timber harvest	In-stream large woody debris frequency per 1,000 linear stream feet
Stream temperature	In-stream temperature rate of change	**Flow regime** + **channel forms** + **riparian condition**	Change in **flow regime** and/or **channel forms**, RMZ timber harvest	Change in mean weekly maximum temperature per stream reach
Macro-invertebrate richness	DEQ macroinvertebrate indexes (MMI[3], RIVPACS[4])	**Flow regime** + **sediment** + **riparian condition** + nutrients	Change in **flow regime** and/or **sediment**, RMZ timber harvest	MMI[3] index, RIVPACS[4] index, DEQ impairment class
	Historic macroinvertebrate index (MVFP[5])	**Flow regime** + **sediment** + **riparian condition** + nutrients	Change in **flow regime** and/or **sediment**, RMZ timber harvest	MVFP[5] index, MVFP[5] impairment class
Connectivity	Accessible habitat (adult fish)	Natural migration barriers, road-stream crossing structure	Road-stream crossing structure installation or removal	Miles of accessible habitat (adult fish)
	Accessible habitat (juvenile fish)	Natural migration barriers, road-stream crossing structure	Road-stream crossing structure installation or removal	Miles of accessible habitat (juvenile fish)

[1] *'Equivalent Clear-cut Area' (ECA): see Hydrology Analysis.*
[2] *'Gross Annual Flow Volume' = 'Water Yield': see Hydrology Analysis.*
[3] *Multimetric macroinvertebrate index (MMI) (Jessup et al 2006).*
[4] *Predictive macroinvertebrate model (RIVPACS) (Hawkins 2005, Feldman 2006).*
[5] *Historic macroinvertebrate index (MVFP) (Bollman 1998, DEQ 2005).*

ANALYSIS AREAS

In order to evaluate the existing environment and potential environmental effects to fisheries resources within the project area, 8 different analysis areas that contain distinct fisheries distributions were identified (see *FIGURE F-1 – FISHERIES ANALYSIS AREAS*). Seven of the analysis areas include the contributing area watersheds of one or more stream drainages; the Swan River analysis area contains stream reaches, but not the contributing area watersheds. The analysis areas were chosen because they include (1) the watersheds or reaches of known or potential fish-bearing streams or lakes and (2) the proposed harvest units and/or associated roads that could have foreseeable measurable or detectable impacts to those fish-bearing streams or lakes. The analysis areas of contributing area watersheds are delineated using *Sixth Code HUC* scale or smaller watershed boundaries.

The fisheries analysis areas closely coincide with the analysis areas used in the *WATERSHED AND HYDROLOGY* and *SOILS* analyses of this document.

ANALYSIS METHODS

The environmental analysis contained in this document will focus primarily on the populations and habitat variables affecting bull trout and westslope cutthroat trout, as these 2 native species are the primary focus of fisheries-related comments developed for the project as a result of public and internal scoping. Furthermore, bull trout and westslope cutthroat trout are also the focus of many sensitive species listings and interagency agreements (see *RELEVANT AGREEMENTS, LAWS, PLANS, RULES AND REGULATIONS* at the beginning of this document), which indicates these 2 species have high intrinsic ecological and social value. The other 8 native species identified as inhabiting some portion of the project area are not identified as endangered, threatened, or sensitive species (*MNHP 2006*). Although those 8 other native species are an integral component of the aquatic ecosystem within the project area, any foreseeable issues or concerns regarding these species' populations or habitat variables can be adequately addressed through an effects analysis for bull trout and westslope cutthroat trout. Eastern brook trout, rainbow trout, and kokanee are nonnative and, to some degree, invasive species that are not a component of the region's historical biodiversity, but any foreseeable issues or concerns regarding these species populations or habitat variables can also be adequately addressed through an effects analysis for bull trout and westslope cutthroat trout.

The existing environment and (if possible) the ranges of existing conditions of bull trout and westslope cutthroat trout populations and habitat variables will be described under *EXISTING ENVIRONMENT* in this analysis. The analysis methods for evaluating existing conditions are described below in *TABLE F-2 – METHODS FOR EVALUATING EXISTING CONDITIONS (EXISTING ENVIRONMENT)*. The potential environmental impacts of the proposed actions to bull trout and westslope cutthroat trout populations and habitat variables will be described under *ENVIRONMENTAL EFFECTS* of this analysis. The analysis methods for evaluating potential environmental impacts are described below in *TABLE F-3 – METHODS FOR EVALUATING ENVIRONMENTAL IMPACTS (ENVIRONMENTAL EFFECTS)*.

FIGURE F-1 – FISHERIES ANALYSIS AREAS

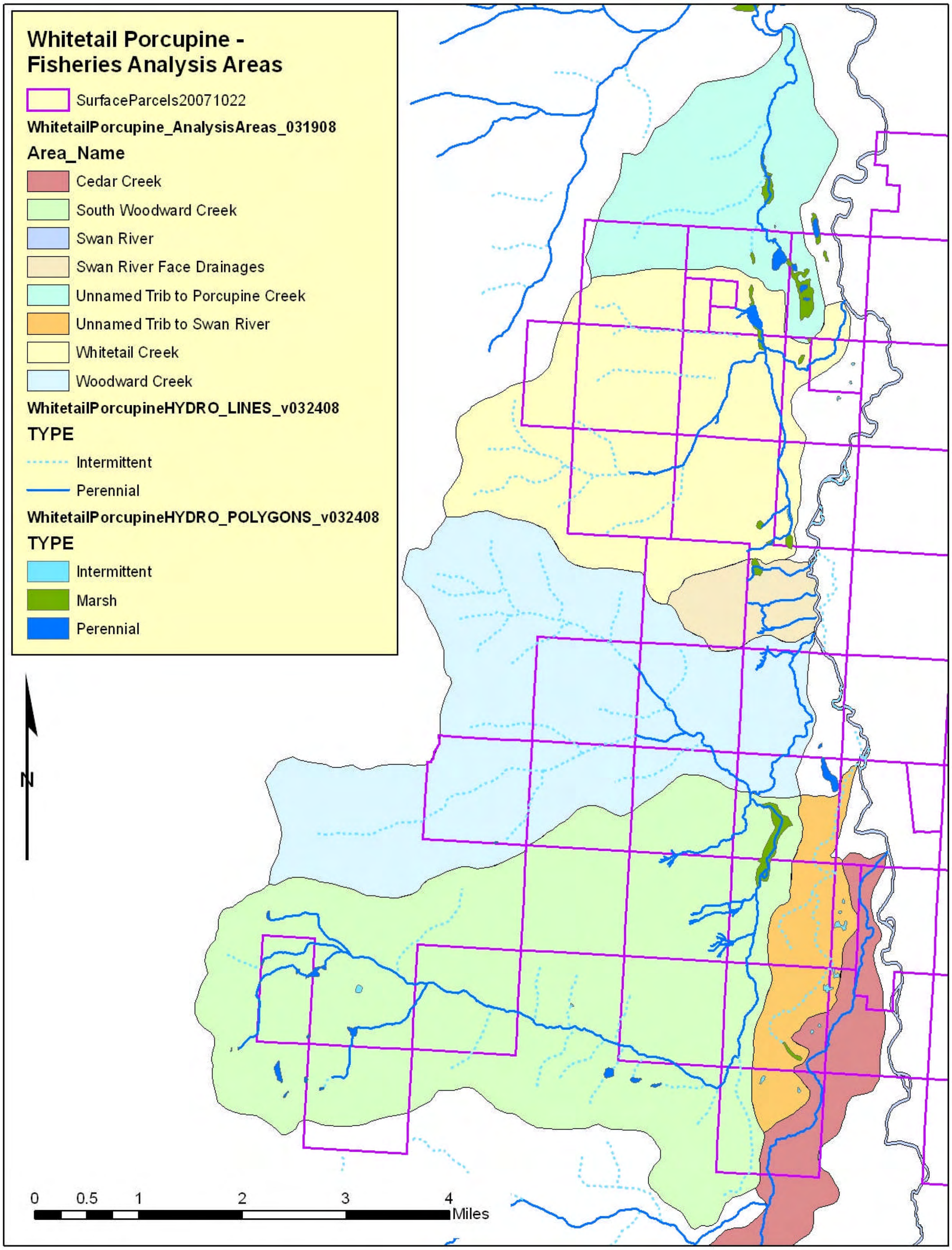


TABLE F-2 – METHODS FOR EVALUATING EXISTING CONDITIONS (EXISTING ENVIRONMENT)

ISSUE	VARIABLE	METHODS TO EVALUATE EXISTING CONDITIONS	METHODS TO EVALUATE THE RANGE OF EXISTING CONDITIONS	EXISTING CONDITIONS
Population	Species presence or absence	Electrofishing or visual verification (direct observation), redd counts (*Weaver and Fraley 1991*), DFWP population surveys, professional judgment	Compilation of applicable past presence or absence data for Swan River State Forest, professional judgment	Compare existing species distribution to historic or otherwise anticipated species distribution
	Genetics	Laboratory analysis (University of Montana) (direct measure)	Compilation of applicable past genetics data for Swan River State Forest, professional judgment	Compare existing species genetics to historic or otherwise anticipated species genetics
Flow regime	Gross annual flow volume	Analysis of current annual water yield[1]	Analysis of historic annual water yields[1]	Compare current annual water yield to historic annual water yields[1]
	Peak seasonal flow volume	Qualitative description of current condition	Qualitative description of past conditions	Qualitative description of current versus historic conditions
	Peak seasonal flow time	Qualitative description of current condition	Qualitative description of past conditions	Qualitative description of current versus historic conditions
	Peak seasonal flow duration	Qualitative description of current condition	Qualitative description of past conditions	Qualitative description of current versus historic conditions
Sediment	Fine sediment	McNeil core (*McNeil and Ahnell 1964*) (direct measurement), quantitative annual sedimentation analysis[1], qualitative description of current condition	Compilation of applicable past McNeil core data for Swan River State Forest	Compare current and (applicable) past McNeil core data, existing rates of annual sedimentation[1]
	Embeddedness (*Sylte and Fischenich 2002*)	Substrate score (*Weaver and Fraley 1991 citing others*) (direct measurement), quantitative annual sedimentation analysis[1], qualitative description of current condition	Compilation of applicable past substrate score data for Swan River State Forest	Compare current and (applicable) past substrate score data, existing rates of annual sedimentation[1]
	Surface substrate size-class distribution	Wolman pebble count (*Wolman 1954*) (direct measurement), quantitative annual sedimentation analysis[1], qualitative description of current condition	Determine expected relative percent of size classes per Rosgen channel type (*Rosgen 1996*), compilation of applicable past substrate size class for Swan River State Forest	Compare current and expected relative percent of size classes per Rosgen channel type (*Rosgen 1996*), compare current and (applicable) past substrate size class data, existing rates of annual sedimentation[1]

TABLE F-2 – METHODS FOR EVALUATING EXISTING CONDITIONS (EXISTING ENVIRONMENT) (continued)

ISSUE	VARIABLE	METHODS TO EVALUATE EXISTING CONDITIONS	METHODS TO EVALUATE THE RANGE OF EXISTING CONDITIONS	EXISTING CONDITIONS
Channel forms	Channel type	Rosgen channel type (*Rosgen 1996*) (direct measure or estimated), Montgomery and Buffington channel types (*Montgomery and Buffington 1997*) (direct observation)	Direct observation, literature descriptions of anticipated conditions (*Rosgen 1996, Montgomery and Buffington 1997*)	Compare existing Rosgen and Montgomery and Buffington channel types to anticipated range of conditions
	Fast/slow fish habitat frequency	R1/R4 Fish Habitat Standard Inventory (*Overton et al 1997*), qualitative description of current condition	Compilation of applicable past habitat frequency data for Swan River State Forest	Compare current and (applicable) past habitat frequency data
	Fast/slow fish habitat volume	R1/R4 Fish Habitat Standard Inventory (*Overton et al 1997*), qualitative description of current condition	Compilation of applicable past habitat volume data for Swan River State Forest	Compare current and (applicable) past habitat volume data
	Channel bank stability	R1/R4 Fish Habitat Standard Inventory (*Overton et al 1997*), qualitative description of current condition[2]	Compilation of applicable past channel-bank-stability data for Swan River State Forest	Compare current and (applicable) past channel-ban-stability data
Riparian condition	Riparian stand characteristics	Average of multiple 1/20-acre fixed riparian timber-cruise plots (direct measure)	Describe range of values from all applicable 1/20-acre fixed riparian timber cruise plots for Swan River State Forest, literature descriptions of historic conditions[3]	Compare average condition to (applicable) range of past riparian-stand-characteristic data
	Riparian habitat type (climax)	Hansen et al (*1995*) (direct observation)	Literature descriptions of anticipated conditions (*Hansen et al 1995*)	Compare direct observation to types to anticipated range of conditions
	Riparian habitat type (regional functionality)	Sirucek and Bachurski (*1995*) (direct observation)	Literature descriptions of anticipated conditions (*Sirucek and Bachurski 1995*)	Compare direct observation to types to anticipated range of conditions
	Rate of riparian tree blowdown	Average rate of riparian tree blowdown (direct measure or estimated)	Describe range of values from all applicable direct measures or estimates	Compare average condition to (applicable) range of direct measures or estimates
	Stream shading	Average angular canopy density using Solar Pathfinder (direct measure)	Describe range of values from all applicable angular canopy measures for Swan River State Forest	Compare average condition to (applicable) range of past angular canopy-density data

TABLE F-2 – METHODS FOR EVALUATING EXISTING CONDITIONS (EXISTING ENVIRONMENT) (continued)

ISSUE	VARIABLE	METHODS TO EVALUATE EXISTING CONDITIONS	METHODS TO EVALUATE THE RANGE OF EXISTING CONDITIONS	EXISTING CONDITIONS
Large woody debris	In-stream large woody debris frequency	R1/R4 Fish Habitat Standard Inventory (*Overton et al 1997*), qualitative description of current condition	Compilation of applicable past in-stream large woody debris frequency data for Swan River State Forest, determine regional statistics (*Bower 2006*)	Compare current condition to regional and (applicable) past in-stream large woody debris frequency data
Stream temperature	In-stream temperature rate of change	Deployment of stream temperature sensors[4] during peak seasonal stream temperatures, determine rate of change in mean weekly maximum temperature	Compilation of applicable past in-stream temperature data for Swan River State Forest	Compare current rate of change in mean weekly maximum temperature to regional and (applicable) past in-stream temperature data
Macro-invertebrate richness	Montana DEQ macroinvertebrate indexes (MMI, RIVPACS)	Replicate sampling protocol as described in *Montana DEQ (2005)*, qualitative description of current condition	Compilation of applicable past macroinvertebrate index data for Swan River State Forest	Compare current indexes to regional and (applicable) past macroinvertebrate index data
	Historic macroinvertebrate index (MVFP)	Replicate sampling protocol as described in *Montana DEQ (2005)*, qualitative description of current condition	Compilation of applicable past macroinvertebrate index data for Swan River State Forest	Compare current indexes to regional and (applicable) past macroinvertebrate index data
Connectivity	Accessible habitat (adult fish)	Survey of road-stream crossing structures utilizing protocols and models: *Cowan (1956), Clarkin et al (2003), WinXSPRO (2005), FishXing (2006)*	Evaluate *EXISTING CONDITIONS* for *Population, species presence or absence*	Compare current levels of adult fish connectivity to the anticipated level of connectivity found in *EXISTING CONDITIONS* for *Population, species presence or absence*
	Accessible habitat (juvenile fish)	Survey of road-stream crossing structures utilizing protocols and models: *Cowan (1956), Clarkin et al (2003), WinXSPRO (2005), FishXing (2006)*	Evaluate *EXISTING CONDITIONS* for *Population, species presence or absence*	Compare current levels of juvenile fish connectivity to anticipated level of connectivity found in *EXISTING CONDITIONS* for *Population, species presence or absence*

[1] *See HYDROLOGY ANALYSIS.*

[2] *Pfankuch (1975) is used as a method to evaluate foreseeable impacts to channel-bank stability in the Hydrology Analysis; however, Overton et al (1997) is used in this Fisheries Analysis for a better assessment of existing stream bank stability relative to fisheries-habitat resources.*

[3] *See VEGETATION ANALYSIS.*

[4] *Equipment includes Onset Computer Corp sensors, accuracy within +/-0.2 degrees Celsius.*

TABLE F-3 – METHODS FOR EVALUATING ENVIRONMENTAL IMPACTS (ENVIRONMENTAL EFFECTS)

ISSUE	VARIABLE	METHODS TO EVALUATE POTENTIAL IMPACTS	POTENTIAL IMPACTS	DEPARTURE OF POTENTIAL IMPACTS FROM EXISTING CONDITIONS
Population	Species presence or absence	Determine direct/indirect manipulation of species presence or absence by proposed actions	Reduced presence of native species; increased presence of nonnative species	Compare anticipated change in species presence or absence to *EXISTING CONDITIONS*
	Genetics	Determine direct/indirect manipulation of species presence or absence by proposed actions	New or increased introgression or hybridization of native species	Compare anticipated change in species genetics to *EXISTING CONDITIONS*
Flow regime	Gross annual flow volume	Model effects of an increase in equivalent clearcut area (ECA) on annual water yield[1], qualitative description of anticipated effects[1]	Short- or long-term increase in annual water yield[1]	Compare anticipated increase in water yield to *EXISTING CONDITIONS*[1]
	Peak seasonal flow volume	Qualitative description of anticipated effects	Short- or long-term change in peak seasonal flow volume	Compare anticipated change in peak seasonal flow volume to *EXISTING CONDITIONS*
	Peak seasonal flow time	Qualitative description of anticipated effects	Short- or long-term change in peak seasonal flow time	Compare anticipated change in peak seasonal flow time to *EXISTING CONDITIONS*
	Peak seasonal flow duration	Qualitative description of anticipated effects	Short- or long-term change in peak seasonal flow duration	Compare anticipated change in peak seasonal flow duration to *EXISTING CONDITIONS*
Sediment	Fine sediment	Quantitative or qualitative analysis of foreseeable annual sedimentation[1], analysis of potential sedimentation from affected RMZs and road-stream crossings, literature review	Short- or long-term increase in percent of fine sediment	Compare anticipated change in percent of fine sediment to *EXISTING CONDITIONS*
	Embeddedness (*Sylte and Fischenich 2002*)	Quantitative or qualitative analysis of foreseeable annual sedimentation[1], analysis of potential sedimentation from affected RMZs and road-stream crossings, literature review	Short- or long-term increase in embeddedness	Compare anticipated change in embeddedness to *EXISTING CONDITIONS*
	Surface substrate size-class distribution	Quantitative or qualitative analysis of foreseeable annual sedimentation[1], analysis of potential sedimentation from affected RMZs and road-stream crossings, literature review	Short- or long-term departures in relative percents of surface substrate size classes, especially fine size classes	Compare anticipated change in relative percents of surface substrate size classes to *EXISTING CONDITIONS*

TABLE F-3 – METHODS FOR EVALUATING ENVIRONMENTAL IMPACTS (ENVIRONMENTAL EFFECTS) (continued)

ISSUE	VARIABLE	METHODS TO EVALUATE POTENTIAL IMPACTS	POTENTIAL IMPACTS	DEPARTURE OF POTENTIAL IMPACTS FROM EXISTING CONDITIONS
Channel forms	Channel type	Impacts are primarily expected to be proportional to potential impacts to *flow regime* and *sediment*	Departure or unstable change in channel type	Compare anticipated change in channel type to existing conditions
	Fast/slow fish habitat frequency	Impacts are primarily expected to be proportional to potential impacts to *flow regime* and *sediment*	Increase in fast habitat frequency; decrease in slow habitat frequency	Compare anticipated change in fast/slow fish habitat frequency to existing conditions
	Fast/slow fish habitat volume	Impacts are primarily expected to be proportional to potential impacts to *flow regime* and *sediment*	Increase in fast habitat volume; decrease in slow habitat volume	Compare anticipated change in fast/slow fish habitat volume to existing conditions
	Channel bank stability	Impacts are primarily expected to be proportional to potential impacts to *flow regime* and *sediment*, qualitative analysis of foreseeable changes to channel bank stability[1]	Decrease in channel bank stability	Compare anticipated change in channel bank stability to existing conditions
Riparian condition	Riparian stand characteristics	Adjust measures of average riparian stand characteristics by applying proposed RMZ harvest prescriptions, calculate affected area	Shift in plant species, short- or long-term departure in average: trees per acre, quadratic mean diameter, and basal area per acre	Compare anticipated change in riparian stand characteristics to existing conditions
	Riparian habitat type (climax)	Literature review of potential changes in habitat type (e.g *Hansen et al 1995*)	Departure in habitat type	Compare anticipated change in riparian habitat type (climax) to existing conditions
	Riparian habitat type (regional functionality)	Literature review of potential changes in habitat type (e.g *Sirucek and Bachurski 1995*)	Departure in habitat type	Compare anticipated change in riparian habitat type (regional functionality) to existing conditions
	Rate of riparian tree blowdown	Estimate change in average rate of riparian tree blowdown by considering adjusted measures of average riparian stand characteristics	Short- or long-term departure in rate of riparian tree blowdown	Compare anticipated change in rate of riparian tree blowdown to existing conditions
	Stream shading	Estimate change in angular canopy density by considering stream aspect and potential impacts to other *riparian condition* variables	Short- or long-term departure in stream shading	Compare anticipated change in stream shading to existing conditions

TABLE F-3 – METHODS FOR EVALUATING ENVIRONMENTAL IMPACTS (ENVIRONMENTAL EFFECTS) (continued)

ISSUE	VARIABLE	METHODS TO EVALUATE POTENTIAL IMPACTS	POTENTIAL IMPACTS	DEPARTURE OF POTENTIAL IMPACTS FROM EXISTING CONDITIONS
Large woody debris	In-stream large woody debris frequency	Calculate change in amount of potentially recruitable large woody debris and rate of riparian tree blow down from potential impacts to *riparian condition*, model anticipated rates of large woody debris recruitment (e.g. *Welty et al 2002*), literature review	Short- or long-term reductions in large woody debris recruitment	Compare anticipated change in large woody debris to *EXISTING CONDITIONS*
Stream temperature	In-stream temperature rate of change	Considering potential impacts to *flow regime, sediment*, and *riparian condition* model anticipated changes in stream temperature (e.g. *Currier and Hughes 1980, Beschta et al 1987, Bartholow 2002*), literature review	Short- or long-term increases in stream temperature	Compare anticipated change in stream temperature to *EXISTING CONDITIONS*
Macro-invertebrate richness	DEQ macroinvertebrate indexes (MMI, RIVPACS)	Literature review while considering potential impacts to *flow regime, sediment*, and *riparian condition*	Decreased/increased macroinvertebrate richness	Compare anticipated change in macroinvertebrate richness to *EXISTING CONDITIONS*
	Historic macroinvertebrate index (MVFP)	Literature review while considering potential impacts to *flow regime, sediment*, and *riparian condition*	Decreased/increased Macroinvertebrate richness	Compare anticipated change in macroinvertebrate richness to *EXISTING CONDITIONS*
Connectivity	Accessible habitat (adult fish)	Calculate change in accessible habitat by restoring or restricting adult fish connectivity	Temporary or permanent change in accessible habitat	Compare anticipated change in accessible habitat (adult fish) to *EXISTING CONDITIONS*
	Accessible habitat (juvenile fish)	Calculate change in accessible habitat by restoring or restricting juvenile fish connectivity	Temporary or permanent change in accessible habitat	Compare anticipated change in accessible habitat (juvenile fish) to *EXISTING CONDITIONS*

Depending on the type and extent of the proposed actions, issues will (or will not) be carried through the analysis methods in each analysis area. The analysis methods described in *TABLES F-2 - METHODS FOR EVALUATING EXISTING CONDITIONS (EXISTING ENVIRONMENT)* and *F-3 - METHODS FOR EVALUATING ENVIRONMENTAL IMPACTS* (*ENVIRONMENTAL EFFECTS*) include the general methodologies considered for the project area; relevant site-specific information will be described for each analysis area in *EXISTING ENVIRONMENT* in this analysis.

Throughout the *EXISTING ENVIRONMENT* and *ENVIRONMENTAL EFFECTS* sections, the risk of a particular impact to fisheries resources is described. In terms of the risk that an impact may occur, a low risk of an impact means that the impact is unlikely to occur. A moderate risk of an impact means that the impact may or may not (50/50) occur. A high risk of an impact means that the impact is likely to occur.

A very low impact means that the impact is unlikely to be detectable or measurable, and the impact is not likely to be detrimental to the resource. A low impact means that the impact is likely to be detectable or measurable, but the impact is not likely to be detrimental to the resource. A moderate impact means that the impact is likely to be detectable or measurable, and the impact is likely to be moderately detrimental to the resource. A high impact means that the impact is likely to be detectable or measurable, and the impact is likely to be highly detrimental to the resource.

Cumulative impacts are those collective impacts on the human environment (e.g. fisheries resources) of the proposed action when considered in conjunction with other past, present, and future actions related to the proposed action by location or generic type (*75-1-220, MCA*). The potential cumulative impacts to fisheries in the analysis areas are determined by assessing the collective anticipated direct and indirect impacts, other related existing actions, and foreseeable future actions affecting the fish-bearing streams.

Existing road density and road stream-crossing density are other variables that have been indirectly correlated to native fisheries population trends across large regional areas (*Quigley and Arbelbide 1997*). The mechanisms through which road density and road stream-crossing density affect native fisheries populations include sedimentation, fishing access, poaching, recreational access, timber harvest access, and grazing and agriculture (*Quigley and Arbelbide 1997, Baxter et al 1999*). As road density and road stream-crossing density are, therefore, very broad surrogates of multiple potential actions, these variables are tools to describe potential cumulative effects to fisheries. In the absence of site-specific fisheries data to describe the existing conditions of the project area, road density and road stream-crossing density could be considered simple, viable measures of potential cumulative effects. However, the level of detailed, project-specific fisheries population and habitat data to be utilized throughout this fisheries analysis is expected to provide a much more accurate and precise baseline for the cumulative-effects analysis of fisheries in the project area. Therefore, road density and road stream-crossing density will not be used as a measure of potential cumulative effects in this analysis.

EXISTING ENVIRONMENT AND ENVIRONMENTAL EFFECTS

The existing environmental assessment for each analysis area includes affected fish species, potential actions that may affect fisheries resources, fisheries resources (issues and variables) that may be affected by potential actions (*TABLE F-1 – ISSUE VARIABLES, NORMAL EFFECT MECHANISM, POTENTIAL EFFECT MECHANISM AND MEASUREMENT CRITERIA*), existing conditions of potentially affected fisheries resources (see *TABLE F-2 – METHODS FOR EVALUATING EXISTING CONDITIONS [EXISTING ENVIRONMENT]*), and other existing information needed for the assessment of cumulative effects.

The environmental effects assessment for each analysis area includes: analysis of potential impacts to affected fisheries resources (see *TABLE F-3 – METHODS FOR EVALUATING ENVIRONMENTAL IMPACTS [ENVIRONMENTAL EFFECTS])*, comparison of potential impacts to existing conditions, and cumulative effects assessment of anticipated collective impacts. The effects assessment for each analysis area will be conducted for all alternatives.

- ***CEDAR CREEK ANALYSIS AREA***

  The proposed actions affecting fisheries resources in the Cedar Creek Analysis Area include use of a major haul route for timber and equipment transportation and minor road-surface maintenance. The point-source mechanism through which fisheries resources are affected by the proposed actions is sediment delivery to fish habitats at a single road-stream crossing (*FIGURE F-2 – DETAIL: CEDAR CREEK, SWAN RIVER, AND UNNAMED TRIBUTARY TO SWAN RIVER ANALYSIS AREAS*). For analysis in this EIS, sediment is the only measurable or detectable fisheries resource variable expected to be potentially affected by the proposed actions.

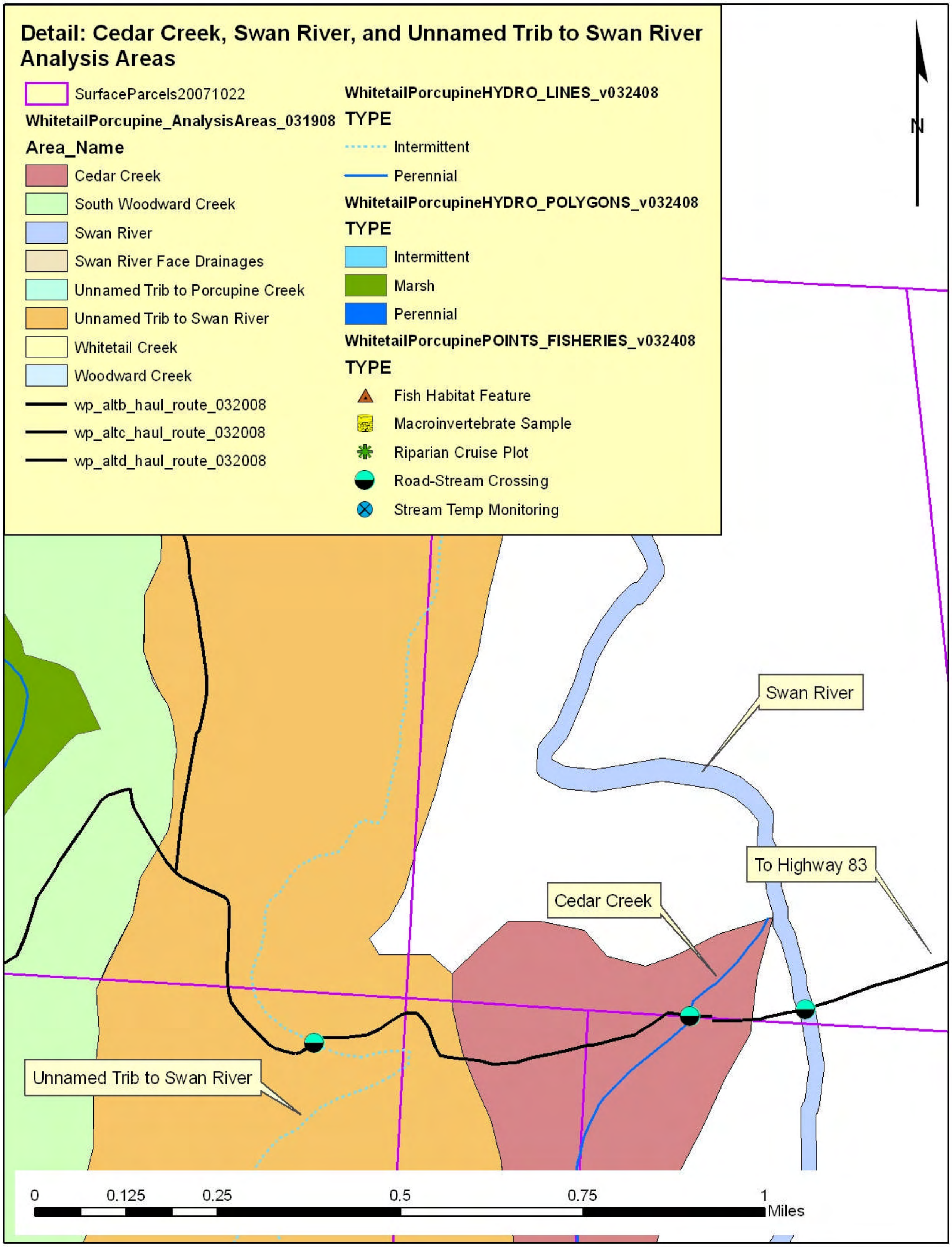
Existing Environment – Cedar Creek Analysis Area

Affected fish species in the Cedar Creek Analysis Area include bull trout, westslope cutthroat trout, longnose sucker, eastern brook trout, and rainbow trout (*MFISH 2007*).

Quantitative data of percent fine sediment (*McNeil core*) or embeddedness (substrate score) is not available for the stream reach adjacent to the proposed road-stream crossing site. Quantitative data of surface substrate size-class distribution indicates fine sediment (0 to 8 millimeters) comprises approximately 8 percent of streambed surface substrates (*Koopal 2002a*), which is below the expected average of 27 percent for the (C4) channel type (*Rosgen 1996*). Quantitative data from other stream reaches in Swan River State Forest with similar channel types and valley locations indicate that the range of fine sediment (0 to 8 millimeters) is approximately 6 to 100 percent, with an average of 44 percent (*Koopal 2001, Koopal 2002b, Koopal 2002c, Koopal 2002d, Sawtelle 2006*).

The existing structure at the road-stream crossing is an elevated concrete bridge with concrete abutments, which is at a low risk of failure during high-flow events. A qualitative field survey for the *HYDROLOGY ANALYSIS* indicates an existing low to moderate risk of sediment delivery to Cedar Creek at the road-

FIGURE F-2 – DETAIL: CEDAR CREEK, SWAN RIVER, AND UNNAMED TRIBUTARY TO THE SWAN RIVER ANALYSIS AREAS



stream crossing site. Based on this information, a low impact to sediment is likely occurring in Cedar Creek, but the existing condition is also likely to be within the expected range of variability found in the stream reach.

Other past and present factors affecting the Cedar Creek Analysis Area include those actions described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED*. These other factors include adverse impacts from nonnative fish species, minor riparian harvesting, low to moderate levels of upland harvesting, timber and equipment hauling by other landowners, and other publicly open road-stream crossing sites. These factors, in conjunction with those site-specific existing conditions assessed above, contribute an existing moderate collective impact to the Cedar Creek Analysis Area.

ENVIRONMENTAL EFFECTS – CEDAR CREEK ANALYSIS AREA

- ***Direct and Indirect Effects of No-Action Alternative A on the Cedar Creek Analysis Area***

  No direct or indirect impacts would occur to affected fish species or other affected fisheries resources beyond those described in *EXISTING ENVIRONMENT*.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D on the Cedar Creek Analysis Area***

  The erosion of forest road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road-surface composition, and road maintenance.

Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates sediment delivery to Cedar Creek is expected to be reduced if any of the 3 action alternatives are selected.

Increased truck traffic can also accelerate the mobilization and erosion of roadbed material at road-stream crossings (*Reid and Dunne 1984, Bilby et al 1989, Coker et al 1993, Luce and Black 2001*). The foreseeable number of passes by project-related vehicles at the Cedar Creek road-stream crossing site is considerable: 10,512 (Action Alternative B), 11,832 (Action Alternative C), and 7,576 (Action Alternative D). (The proposed harvest volumes of Action Alternatives B, C, and D are, respectively, 21.5, 24.2, and 15.5 MMbf.) The average timber load per log truck is approximately 4.5 Mbf (*K. Baker, DNRC, personal communication*), and one support vehicle is estimated to enter the project area for every 10 log trucks. However, the Cedar Creek road-stream crossing site would be partially elevated and is designed to route most mobilized sediment away from the stream and road prism and filter eroded material through roadside vegetation, which is expected to substantially offset the risk of increased sedimentation due to the anticipated high levels of project-specific vehicle traffic.

Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to Cedar Creek from increased project-specific traffic, a net low risk of low impacts to affected fish species and affected fisheries resources (sediment) is expected.

- ***Cumulative Effects of No-Action Alternative A on the Cedar Creek Analysis Area***

  The other related past and present factors and site-specific existing conditions described in *EXISTING ENVIRONMENT* would continue to occur. Other future related actions include those described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED* and the potential conversion of forest timberlands to residential use; these actions are expected to have a low risk of low impacts to fisheries resources. Considering all of these impacts collectively, a moderate risk of moderate cumulative impacts is expected to occur. Although the anticipated moderate cumulative effect is a function of all potential related impacts, the elevated cumulative effect in the analysis area is primarily due to adverse impacts from nonnative fish species.

- ***Cumulative Effects of Action Alternatives B, C, and D on the Cedar Creek Analysis Area***

  Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from all action alternatives may cause an additional risk of impact to fisheries resources. Consequently, a moderate risk of moderate cumulative impacts to fisheries resources is expected in the analysis area.

➢ *SOUTH WOODWARD CREEK ANALYSIS AREA*

The proposed actions affecting fisheries resources in the South Woodward Creek Analysis Area include:

- use of a major haul route for timber and equipment transportation,
- minor road-surface maintenance,
- road construction,
- upland harvesting, and
- riparian harvesting.

The primary point-source mechanism through which fisheries resources are affected by the proposed actions is sediment delivery to fish habitats at 4 road crossings of perennial stream reaches (see *FIGURE F-3 – DETAIL: SOUTH WOODWARD CREEK ANALYSIS AREA*). The primary nonpoint-source mechanisms through which fisheries resources are affected by the proposed actions are (1) modifications of flow regime from upland harvesting, (2) sediment delivery from riparian harvesting, and (3) effects to large woody debris and stream temperature from riparian harvesting. For analysis in this EIS, flow regime, sediment, channel forms, riparian conditions, large woody debris, stream temperature, and macroinvertebrate richness are the measurable or detectable fisheries resources expected to be potentially affected by the proposed actions.

Existing Environment – South Woodward Creek Analysis Area

Affected fish species in the South Woodward Creek Analysis Area include bull trout, westslope cutthroat trout, and eastern brook trout (*MFISH 2007*). Fish presence/absence surveys by DNRC specialists during 2007 identified an isolated westslope cutthroat trout population adjacent to proposed harvest unit '232619'. This population is isolated from upstream migration primarily due to 2 culvert barriers at road-stream crossings on private lands (see *FIGURE F-3 – DETAIL: SOUTH WOODWARD CREEK ANALYSIS AREA*). The 2 culvert barriers on private lands do not prevent the downstream migration of isolated westslope cutthroat trout. The population is presumed to be genetically pure.

The analysis of hydrologic data for South Woodward Creek indicates that the existing average departure in water yield is approximately 8.3 percent above the range of naturally occurring conditions (see *HYDROLOGY ANALYSIS*), which is primarily a result of past forest-crown removal from timber harvesting. The variables of existing peak seasonal flow volume, flow time, and flow duration are expected to be within the range of natural variability.

Quantitative data of percent fine sediment (*McNeil core*), embeddedness (substrate score), or surface substrate size-class distribution is not available for the stream reach adjacent to proposed harvest unit '232619'. Qualitative data from surveys of that reach during 2007 by DNRC specialists indicate fine sediment (0 to 8 millimeters) averages 45 percent of surface substrates, and the observed range is 40 to 55 percent. These measures are above the expected average of 33 percent for the (B4) channel type (*Rosgen 1996*), but are not necessarily unexpected due to the stable, spring-fed-dominated flow regime of the stream. Downstream reaches of South Woodward Creek exhibit an average percent fine sediment (*McNeil core*) of 28.5 percent (range of 24.9 to 34.1 percent, 1996 through 2007) (*T. Weaver, DFWP Kalispell*), an average substrate score (embeddedness) of 9.6 (range of 9.0 to 10.6, 1997 through 2007) (*T. Weaver, DFWP Kalispell*), and surface substrate fine sediment (0 to 8 millimeters) ranging from 6 to 100 percent (*Koopal 2002d*). Although the average substrate score of 9.6 may indicate a condition that threatens native species embryo survival (*FBC 1991*), the condition is not necessarily unexpected due to the stable, spring-fed-dominated flow regime of the stream.

The existing structures at the 4 road-stream crossings include 2 bridges and 2 culverts, all of which are at a low risk of failure during high-flow events. A quantitative field survey for the *HYDROLOGY ANALYSIS* indicates approximately 23.6 tons per year of fine sediment are delivered to the South Woodward Creek Analysis Area from all road-stream crossing sites. Based on this information, a low to moderate impact to sediment is likely occurring in South Woodward Creek, but the existing condition may be within the expected range of variability found in the stream reach.

The channel form adjacent to proposed harvest unit '232619' is described as exhibiting a B4 channel type (*Rosgen 1996*) with forced step-pool and lesser amounts of step-pool features (*Montgomery and Buffington 1997*). 'Slow' habitat features (*Overton et al 1997*) comprise 30 to 50 percent of the stream area and 50 to 60 percent of the stream volume. Over 98 percent of channel banks were observed to be stable (*Overton et al 1997*).

Riparian surveys by DNRC specialists during 2007 found the following stand characteristics adjacent to proposed harvest unit '232619':

- average trees per acre = 1,833 (range: 1,230 to 2,580),
- average quadratic mean diameter (inches) = 8.0 (range: 5.5 to 11.6),
- average basal area (square feet) per acre = 633.9 (range: 376.8 to 904.8), and
- average height (feet) of site index trees at 100 years = 77 (range: 40 to 127).

The general width of the functional riparian area (*Hansen et al 1995*) ranges from 30 to 110 feet. Observed rates of riparian vegetation blowdown appear normal. Measures of angular canopy density for the month of July indicate an average stream shading of 88 percent (range: 82 to 96 percent); measures for the month of August indicate an average of 89 percent (range: 78 to 94 percent).

The predominant riparian stand type along South Woodward Creek within the analysis area is western red cedar/devil's club. Although western red cedar is typically the dominant species during late seral and climax stages, other species such as grand fir, Engelmann spruce, and subalpine fir are also minor components of the overstory (*Hansen et al 1995*). The riparian stand as it relates to the associated geology and soils can be classified as exhibiting SL2B characteristics, which primarily occur adjacent to B and C channel types with stream gradients ranging from 1 to 12 percent (*Sirucek and Bachurski 1995*). Where the SL2B riparian landtype occurs with the stand characteristics described above, expected conditions are somewhat poorly drained sites with deep, weakly developed, gravely or bouldery, sandy loams or loams (*Sirucek and Bachurski 1995*).

Surveys adjacent to proposed harvest unit '232619' by DNRC specialists during 2007 found an average of 129 pieces of large woody debris (*Overton et al 1997*) per 1,000 feet of stream. Data from reference reaches (*Harrelson et al 1994*) throughout the Flathead River basin region indicate that the average expected large woody debris count (pieces per 1,000 feet) in undisturbed B channels is 123 (range: 74 to 172) (*Bower 2006*). This data suggests that the existing frequencies of large woody debris adjacent to the potentially affected area are within the expected range of frequencies when compared to reference reaches in the region with similar morphological characteristics.

Data of in-stream temperature rate of change is not available for the analysis area. Instantaneous daytime measures of temperature adjacent to proposed harvest unit '232619' during August 2007 were approximately 6.6 to 7.0 degrees Celsius. The condition is relatively cold for August, but not unexpected due to the spring-fed-dominated flow regime of South Woodward Creek.

An analysis of replicate macroinvertebrate samples taken during August 2007 adjacent to proposed harvest unit '232619' indicate an "unimpaired" stream condition according to DEQ and historic macroinvertebrate indexes (*Bollman 2008*).

Based on the above assessment of existing conditions, low existing impacts to flow regime and low to moderate impacts to sediment appear to occur. Other past and present factors affecting the South Woodward Creek Analysis Area include those actions described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED*. These other factors include adverse impacts from nonnative fish species, moderate levels of riparian harvesting, moderate levels of upland harvesting, timber and equipment hauling by other landowners, and other publicly open road-stream crossing sites. These factors, in conjunction with those site-specific existing conditions assessed above, contribute an existing moderate collective impact to the South Woodward Creek Analysis Area.

ENVIRONMENTAL EFFECTS – SOUTH WOODWARD CREEK ANALYSIS AREA

- ***Direct and Indirect Effects of No-Action Alternative A on the South Woodward Creek Analysis Area***

  No direct or indirect impacts would occur to affected fish species or other affected fisheries resources beyond those described in *EXISTING ENVIRONMENT*.

- ***Direct and Indirect Effects of Action Alternative B on the South Woodward Creek Analysis Area***

  The *HYDROLOGY ANALYSIS* indicates the proposed actions related to Action Alternative B are expected to result in a cumulative increase in water yield of 8.9 percent in South Woodward Creek. The expected increase in water yield is 0.6 percent above the existing condition. Peak seasonal flow volumes may be slightly greater, peak seasonal flow time may be slightly earlier, and peak seasonal flow duration may be slightly longer. However, these expected minor departures in flow regime are not likely to have detectable or otherwise measurable effects to fisheries resources in South Woodward Creek, and these effects are representative of a moderate risk of very low impacts to flow regime.

  The erosion of forest road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates that an 18-percent reduction in sediment delivery to South Woodward Creek is expected if Action Alternative B is selected. New road construction would not occur near water resources and is expected to present an overall low risk of very low impacts to sediment in South Woodward Creek.

  Increased truck traffic can also accelerate the mobilization and erosion of roadbed material at road-stream crossings (*Reid and Dunne 1984, Bilby et al 1989, Coker et al 1993, Luce and Black 2001*). The foreseeable total number of passes by project-related vehicles at all perennial road-stream crossing sites is approximately 3,110. (For analysis details see *SECTION 1* of the document titled: *WHITETAIL PORCUPINE EIS, FISHERIES ANALYSIS: SUPPLEMENTAL ANALYSIS DETAILS, 15 MAY 2008* in the project file.) However, through the implementation of project-specific BMPs and road maintenance, the applicable road-stream crossing sites would be expected to deliver most mobilized sediment away from the stream and road prism and filter eroded material through roadside vegetation. These actions are expected to substantially offset the risk of increased sedimentation due to the anticipated levels of project-specific vehicle traffic.

A 150-foot equipment- and harvest-exclusion zone would be implemented along South Woodward Creek adjacent to proposed harvest unit '232619' (see *FIGURE F-3 – DETAIL: SOUTH WOODWARD CREEK ANALYSIS AREA*), which is expected to greatly reduce potential sediment delivery from ground disturbances related to upland harvesting (*Davies and Nelson 1994*, *Castelle and Johnson 2000*, *Parker 2005*, *Rashin et al 2006*). Application of the SMZ Law is expected to reduce potential sediment delivery from ground disturbances adjacent to perennial and intermittent, non-fish-bearing streams in the analysis area.

Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to South Woodward Creek from increased project-specific traffic and new road construction, a net low risk of low impacts to affected fish species and affected fisheries resources (sediment) is expected.

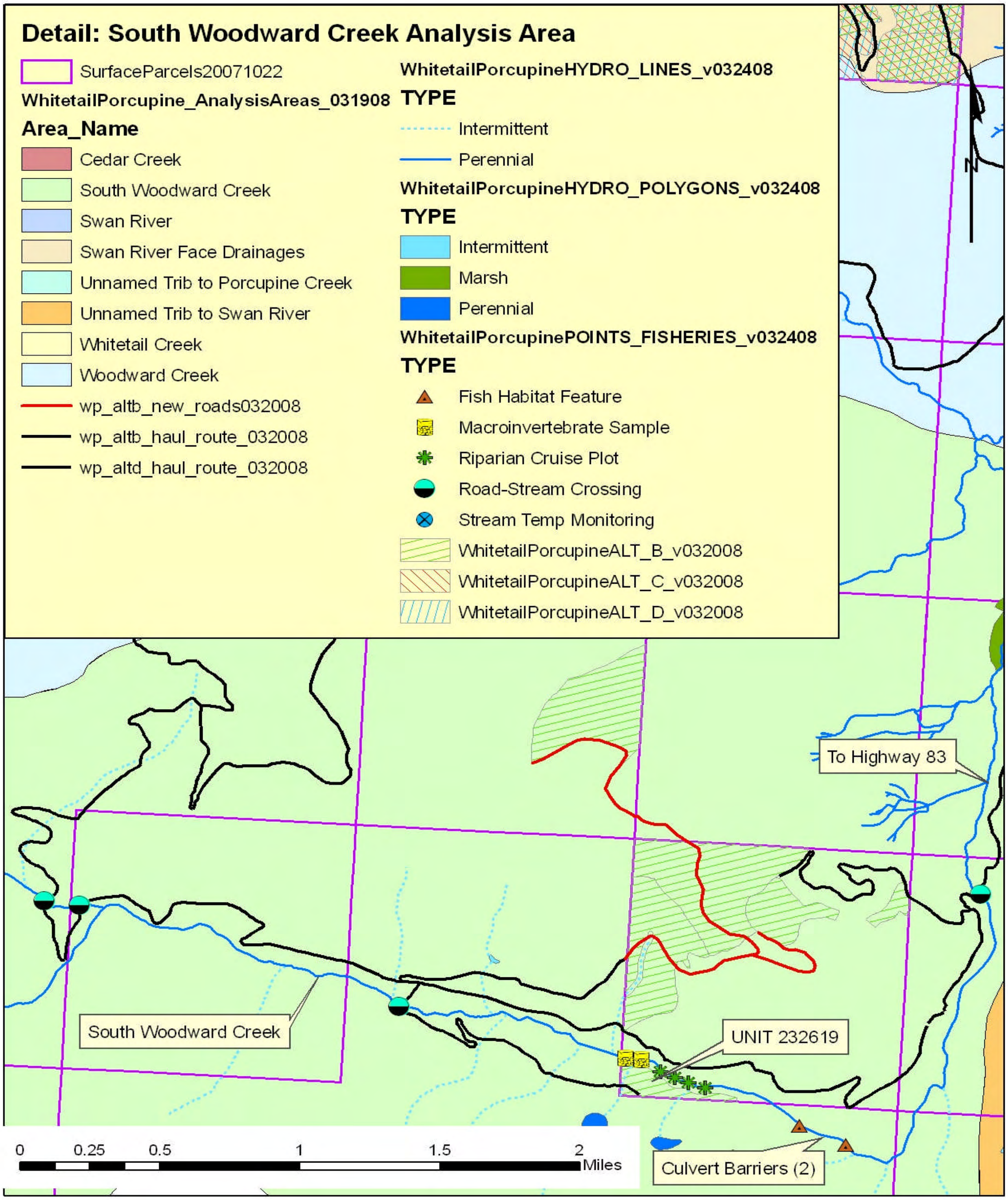
Potential impacts to channel forms are expected to be primarily a function of changes in flow regime and sediment. As a result, a proportional, or low impact is expected to all channel-form variables.

A 150-foot wide, no-harvest zone would be implemented along South Woodward Creek adjacent to proposed harvest unit '232619'. As a result of the proposed action, riparian stand characteristics and habitat types are not expected to be affected. Due to hydrologic and soil features associated with the riparian habitat type, the rate of riparian tree blowdown may increase (*Hansen et al 1995*, *Sirucek and Bachurski 1995*). Scientific literature reviews (*Belt et al 1992, McGreer 1994, Castelle and Johnson 2000*) suggest a no-harvest zone of this extent is expected to greatly reduce potential upland harvesting effects to in-stream shading.

Considering riparian stand characteristics and implementation of a 150-foot wide, no-harvest zone, potential impacts to large woody debris in South Woodward Creek are expected to be greatly reduced; this assessment is based on similar observations from other related studies (*Murphy and Koski 1989*, *McDade et al 1990*, *Robinson and Beschta 1990*, *Van Sickle and Gregory 1990*).

The mean weekly maximum stream temperature may increase slightly due to the potential effects to flow regime and sediment. Implementation of a 150-foot-wide, no-harvest zone to South Woodward Creek is expected to greatly reduce the potential effects to stream temperature as a result of potential changes to the riparian condition (*Beschta et al 1987*, *Brosofske et al 1997*, *Wilkerson et al 2006*). Application of the

FIGURE F-3 – DETAIL: SOUTH WOODWARD CREEK ANALYSIS AREA



SMZ Law is expected to reduce the potential effects to stream temperature in perennial and intermittent, non-fish-bearing streams in the analysis area.

Macroinvertebrate richness may decrease slightly due to the potential effects to flow regime and sediment (*Herlihy et al 2005*, *VanDusen et al 2005*). Implementation of a 150-foot wide, no-harvest zone is expected to greatly reduce the potential positive or adverse effects to macroinvertebrate richness as a result of potential changes to the riparian condition (*Newbold et al 1980*, *Carlson et al 1990*, *Moldenke and Ver Linden 2007*).

A very low risk of low adverse impacts to the riparian condition, large woody debris, stream temperature, and macroinvertebrate richness is expected as a result of implementing Action Alternative B.

- ***Direct and Indirect Effects of Action Alternative C on the South Woodward Creek Analysis Area***

No proposed actions would occur in the analysis area; no direct or indirect impacts would occur to affected fish species or other affected fisheries resources beyond those described in *EXISTING ENVIRONMENT*.

- ***Direct and Indirect Effects of Action Alternative D on the South Woodward Creek Analysis Area***

Proposed actions in the analysis area are limited to the use of a major haul route for timber and equipment transportation and minor road-surface maintenance.

The erosion of forest road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates a 14-percent reduction in sediment delivery to South Woodward Creek is expected if Action Alternative D is selected.

Increased truck traffic can also accelerate the mobilization and erosion of roadbed material at road-stream crossings (*Reid and Dunne 1984, Bilby et al 1989, Coker et al 1993, Luce and Black 2001*). The foreseeable total number of passes by project-related vehicles at all perennial road-stream crossing sites is approximately 2,056. (For analysis details see '*SECTION 2*' of the document titled: '*WHITETAIL PORCUPINE EIS, FISHERIES ANALYSIS: SUPPLEMENTAL ANALYSIS DETAILS, 15 MAY 2008*' in the project file.) However, through the implementation of project-specific BMPs and road maintenance, the applicable road-stream crossing sites would be expected to deliver most mobilized sediment away from the stream and road prism and filter eroded material through roadside vegetation. These actions are expected to substantially offset the risk of increased sedimentation due to the anticipated levels of project-specific vehicle traffic.

Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to South Woodward Creek from increased project-specific traffic, a net low risk of low impacts to affected fish species and fisheries resources (sediment) is expected.

Potential impacts to channel forms are expected to be primarily a function of changes in sediment. However, since no impacts to flow regime are expected, an overall low risk of very low impacts to all channel-form variables is anticipated.

The mean weekly maximum stream temperature may increase slightly due to potential effects to sediment, but this impact is expected to be very low.

Macroinvertebrate richness may decrease slightly due to potential effects to sediment (*Herlihy et al 2005*, *VanDusen et al 2005*), but this impact is also expected to be very low.

- ***Cumulative Effects of No-Action Alternative A on the South Woodward Creek Analysis Area***

The other related past and present factors and site-specific existing conditions described in *EXISTING ENVIRONMENT* would continue to occur. Other future related actions include those described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED*, moderate levels of timber harvesting and associated road use on private lands and the potential conversion of forest timberlands to residential use; these actions are expected to have a moderate risk of low impacts to fisheries resources. Considering all of these impacts collectively, a moderate risk of moderate cumulative impacts is expected to occur. Although the anticipated moderate cumulative effect is a function of all potential related impacts, the elevated cumulative effect in the analysis area is primarily due to adverse impacts from nonnative fish species.

- ***Cumulative Effects of Action Alternative B on the South Woodward Creek Analysis Area***

A gravel pit would be developed in the analysis area for generating new road material (see *GEOLOGY AND SOILS ANALYSIS*), but this gravel pit is not expected to affect water or fisheries resources (see *HYDROLOGY ANALYSIS*). Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from Action Alternative B may cause additional low impacts to multiple fisheries resources. Consequently, a moderate to high risk of moderate cumulative impacts to fisheries resources is expected in the analysis area.

- ***Cumulative Effects of Action Alternative C on the South Woodward Creek Analysis Area***

A gravel pit would be developed in the analysis area for generating new road material (see *GEOLOGY AND SOILS ANALYSIS*), but this gravel pit is not expected to affect water or fisheries resources (see *HYDROLOGY ANALYSIS*). Cumulative effects to fisheries resources in the analysis area are expected to be the same as those described for No-Action Alternative A.

- ***Cumulative Effects of Action Alternative D on the South Woodward Creek Analysis Area***

A gravel pit would be developed in the analysis area for generating new road material (see *GEOLOGY AND SOILS ANALYSIS*), but this gravel pit is not expected to affect water or fisheries resources (see *HYDROLOGY ANALYSIS*). Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from Action Alternative D may cause additional very low to low impacts to a subset of fisheries resources. Consequently, a moderate risk of moderate cumulative impacts to fisheries resources is expected in the analysis area.

- **SWAN RIVER ANALYSIS AREA**

The proposed actions affecting fisheries resources in the Swan River Analysis Area include use of a major haul route for timber and equipment transportation and minor road-surface maintenance. The point-source mechanism through which fisheries resources are affected by the proposed actions is sediment delivery to fish habitats at a single road-stream crossing (see *FIGURE F-2 – DETAIL CEDAR CREEK, SWAN RIVER*, and *UNNAMED TRIBUTARY TO THE SWAN RIVER ANALYSIS AREAS*). For analysis in this EIS, sediment is the only measurable or detectable fisheries resource expected to be potentially affected by the proposed actions.

EXISTING ENVIRONMENT – SWAN RIVER ANALYSIS AREA

Affected fish species in the Swan River Analysis Area include bull trout, westslope cutthroat trout, slimy sculpin, largescale sucker, longnose sucker, longnose dace, mountain whitefish, northern pike minnow, peamouth, redside shiner, eastern brook trout, rainbow trout, and kokanee (*MFISH 2007*).

Quantitative data of percent fine sediment (*McNeil core*), embeddedness (substrate score), or surface substrate size class distribution is not available for the stream reach adjacent to the proposed road-stream crossing site. Field reviews during 2007 by a DNRC fish biologist and hydrologist indicate a normal distribution of substrate size classes is likely in the stream reach adjacent to the proposed road-stream crossing site.

The existing structure at the road-stream crossing is an elevated concrete bridge with concrete abutments, which is at a very low risk of failure during high-flow events. A qualitative field survey for the *HYDROLOGY ANALYSIS* indicates an existing very low risk of sediment delivery to Swan River at the road-stream crossing site. Based on this information, a very low impact to sediment is likely occurring in Swan River, but the existing condition is also likely to be within the expected range of variability found in the stream reach.

Other past and present factors affecting the Swan River Analysis Area include those actions described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1- PURPOSE AND NEED*. These other factors include adverse impacts from nonnative fish species, minor riparian harvesting, low to moderate levels of upland harvesting, timber and equipment hauling by other landowners, and other publicly open road-stream crossing sites. These other factors, in conjunction with those site-specific existing conditions assessed above, contribute an existing moderate collective impact to the Swan River Analysis Area.

ENVIRONMENTAL EFFECTS – SWAN RIVER ANALYSIS AREA

- ***Direct and Indirect Effects of No-Action Alternative A on the Swan River Analysis Area***

  No direct or indirect impacts would occur to affected fish species or other affected fisheries resources beyond those described in *EXISTING ENVIRONMENT*.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D on the Swan River Analysis Area***

  The erosion of forest road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road-surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates sediment delivery to Swan River is expected to be reduced if any of the 3 action alternatives are selected.

  The assessment of potential impacts to the Swan River Analysis Area is expected to be very similar to that of the Cedar Creek Analysis Area:

  1. The Swan River road-stream crossing structure is similar in design and function to the Cedar Creek road-stream structure.
  2. The proposed actions of all action alternatives are the same for both analysis areas.

  Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to Swan River from increased project-specific traffic, a net low risk of low impacts to affected fish species and affected fisheries resources (sediment) is expected.

- ***Cumulative Effects of No-Action Alternative A on the Swan River Analysis Area***

  The other related past and present factors and site-specific existing conditions described in *EXISTING ENVIRONMENT* would continue to occur. Other future related actions include those described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED* and the potential conversion of forest timberlands to residential use; these actions are expected to have a low risk of low impacts to fisheries resources. Considering all of these impacts collectively, a moderate risk of moderate cumulative impacts is expected to occur. Although the anticipated moderate cumulative effect is a function of all potential related impacts, the elevated cumulative effect in the analysis area is primarily due to adverse impacts from nonnative fish species.

- ***Cumulative Effects of Action Alternatives B, C, and D on the Swan River Analysis Area***

  Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from all action alternatives may cause an additional risk of impact to fisheries resources. Consequently, a moderate risk of moderate cumulative impacts to fisheries resources is expected in the analysis area.

- **SWAN RIVER FACE DRAINAGES ANALYSIS AREA**

The proposed actions affecting fisheries resources in the Swan River Face Drainages Analysis Area include:

- use of a major haul route for timber and equipment transportation,
- substantial road surface maintenance,
- new road construction,
- upland harvesting, and
- riparian harvesting.

The primary point-source mechanism through which fisheries resources are affected by the proposed actions is sediment delivery to fish habitats at 3 road crossings of perennial stream reaches (see *FIGURE F-4 – DETAIL: SWAN RIVER FACE DRAINAGES ANALYSIS AREA*). The primary nonpoint-source mechanisms through which fisheries resources are affected by the proposed actions are modifications of flow regime from upland harvesting and sediment delivery from riparian harvesting. For analysis in this EIS, flow regime, sediment, channel forms, and macroinvertebrate richness are the measurable or detectable fisheries resources expected to be potentially affected by the proposed actions.

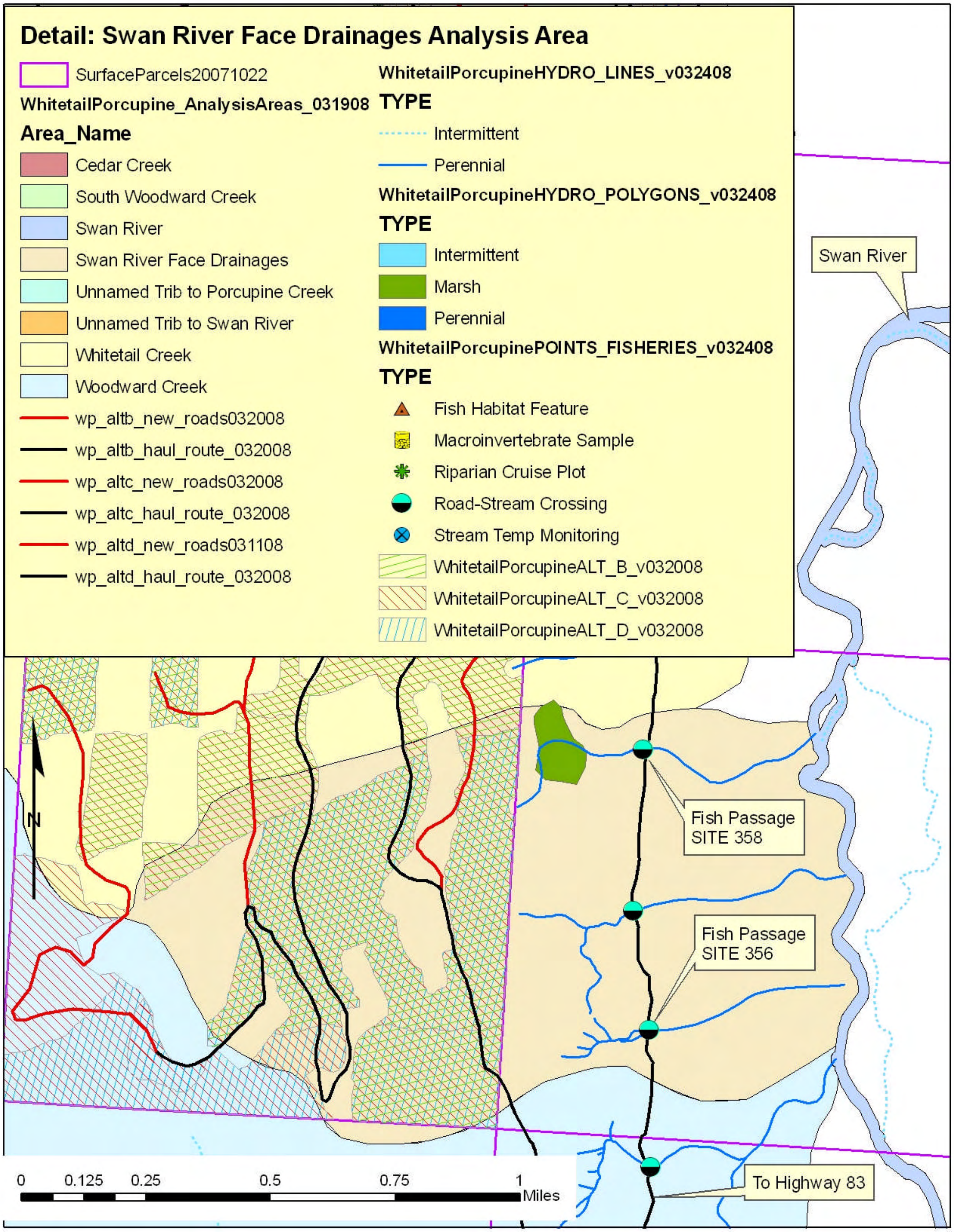
The resources of riparian conditions, large woody debris, and stream temperature will not be carried through additional analysis since (1) potential riparian harvesting would only occur adjacent to the terminus (seep) of a non-fish-bearing stream reach, and (2) no potential riparian harvesting would occur along any other perennial fish-bearing, perennial non-fish-bearing, or intermittent reaches. No measurable or detectable effect on riparian conditions, large woody debris, or stream temperature is expected to occur at the stream terminus (seep). Although connectivity at 'Fish Passage Sites 356 and 358' (see below) is impaired, no proposed actions would affect this variable; therefore, an effects assessment is not needed for this particular resource.

EXISTING ENVIRONMENT – SWAN RIVER FACE DRAINAGES ANALYSIS AREA

Affected fish species in the Swan River Face Drainages Analysis Area include westslope cutthroat trout and eastern brook trout. Fish presence/absence surveys by DNRC specialists during 2007 identified 3 fish-bearing tributaries to Swan River, which intersect the major haul route at 'Fish Passage Sites 356 and 358' and one other location between the 2 fish passage sites (see *FIGURE F-4 – DETAIL: SWAN RIVER FACE DRAINAGES ANALYSIS AREA*). Eastern brook trout are the only fish species found in all 3 streams at this time, but all 3 entire stream systems very likely contained westslope cutthroat trout and, to a limited extent, bull trout and sculpin during presettlement. For the purposes of this environmental assessment, all 3 streams will be considered westslope cutthroat trout habitat.

The qualitative assessment of hydrologic data for this analysis area indicates that the existing average departure in water yield is likely above the range of naturally occurring conditions (see *HYDROLOGY*

FIGURE F-4 – DETAIL: SWAN RIVER FACE DRAINAGES ANALYSIS AREA



ANALYSIS), which is primarily a result of past forest-crown removal. The variables of existing peak seasonal flow volume, flow time, and flow duration are expected to be within the range of natural variability.

Quantitative data of percent fine sediment (*McNeil* core), embeddedness (substrate score), or surface substrate size-class distribution is not available for the stream reach adjacent to the proposed road-stream crossing site. Field reviews during 2007 by a DNRC fish biologist indicate that there is likely a normal distribution of substrate size classes in all 3 stream reaches when considering the streams' variable morphologies. From north to south, the streams primarily exhibit A4, C4/C5, and B4/B5 characteristics, which contain relatively high amounts of fine materials. The sediment conditions are not necessarily unexpected due to the stable, spring-fed-dominated flow regime of the streams.

The existing structures at the 3 road-stream crossings are culverts, all of which are at a low risk of failure during high-flow events. A qualitative field survey for the *HYDROLOGY ANALYSIS* indicates a low level of fine sediment is delivered to the Swan River Face Drainages Analysis Area from all road-stream crossing sites. Based on this information, a low impact to sediment is likely occurring in the 3 stream reaches, but the existing condition is also likely to be within the expected range of variability found in the stream reach.

Channel banks throughout the analysis area were observed to be stable (*Overton et al 1997*). Descriptions of channel type using *Montgomery and Buffington (1997*) are not available.

A quantitative analysis of macroinvertebrate samples and index derivation is not available for any of the 3 stream systems in the analysis area. No conditions were observed in any of the streams that may indicate a range of macroinvertebrate richness not consistent with the stream morphologies and stable, spring-fed-dominated flow regimes.

Based on the above assessment of existing conditions, low existing impacts to flow regime and sediment appear to occur. Other past and present factors affecting the Swan River Face Drainages Analysis Area include those actions described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED*. Those other factors include adverse impacts from nonnative fish species, moderate levels of riparian harvesting, moderate levels of upland harvesting, and timber and equipment hauling by other landowners. These other factors, in conjunction with those site-specific existing conditions assessed above, contribute an existing moderate collective impact to the Swan River Face Drainages Analysis Area.

ENVIRONMENTAL EFFECTS – SWAN RIVER FACE DRAINAGES ANALYSIS AREA

- ***Direct and Indirect Effects of No-Action Alternative A on the Swan River Face Drainages Analysis Area***

  No direct or indirect impacts would occur to affected fish species or other affected fisheries resources beyond those described in *EXISTING ENVIRONMENT*.

- ***Direct and Indirect Effects of Action Alternatives B and D on the Swan River Face Drainages Analysis Area***

The *HYDROLOGY ANALYSIS* indicates that the proposed actions related to Action Alternatives B and D are expected to result in a cumulative increase in water yield in the 3 stream drainages. Peak seasonal flow volumes may be slightly greater, peak seasonal flow time may be slightly earlier, and peak seasonal flow duration may be slightly longer. These expected departures in flow regime may have a detectable or otherwise measurable effect to fisheries resources in the 3 stream drainages, and these effects are representative of a moderate risk of low impacts to flow regime.

The erosion of forest road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates sediment delivery to the Swan River Face Drainages Analysis Area is expected to be reduced if Action Alternative B or D is selected. The new road construction would not occur near water resources and is expected to present an overall low risk of very low impacts to sediment in the analysis area.

Increased truck traffic can also accelerate the mobilization and erosion of roadbed material at road-stream crossings (*Reid and Dunne 1984*, *Bilby et al 1989*, *Coker et al 1993*, *Luce and Black 2001*). The foreseeable total number of passes by project-related vehicles at all perennial road-stream crossing sites is approximately 8,592 for Action Alternative B and 7,464 for Action Alternative D. (For analysis details see *SECTION 9* and *SECTION 11* of the document titled *WHITETAIL PORCUPINE EIS, FISHERIES ANALYSIS: SUPPLEMENTAL ANALYSIS DETAILS, 15 MAY 2008* in the project file.) However, through the implementation of project-specific BMPs and road maintenance, the applicable road-stream crossing sites would be expected to deliver most mobilized sediment away from the stream and road prism and filter eroded material through roadside vegetation. These actions are expected to substantially offset the risk of increased sedimentation due to the anticipated levels of project-specific vehicle traffic.

A 100-foot equipment restriction zone would be implemented adjacent to the terminus (seep) of a non-fish-bearing stream reach, which is expected to reduce potential sediment delivery from ground disturbances related to upland harvesting (*Davies and Nelson 1994*, *Castelle and Johnson 2000*, *Parker 2005*, *Rashin et al 2006*).

Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to the 3 streams from increased project-specific traffic, a net low risk of low impacts to affected fish species and affected fisheries resources (sediment) is expected.

Potential impacts to channel forms are expected to be primarily a function of changes in flow regime and sediment. As a result, a proportional, or low, impact is expected to channel form variables.

Macroinvertebrate richness may decrease slightly due to potential effects to flow regime and sediment (*Herlihy et al 2005*, *VanDusen et al 2005*).

- ***Direct and Indirect Effects of Action Alternative C on the Swan River Face Drainages Analysis Area***

The *HYDROLOGY ANALYSIS* indicates the proposed actions related to Action Alternative C are expected to result in a cumulative increase in water yield in the 3 stream drainages. Peak seasonal flow volumes may be slightly greater, peak seasonal flow time may be slightly earlier, and peak seasonal flow duration may be slightly longer. These expected departures in flow regime may have a detectable or otherwise measurable effect to fisheries resources in the 3 stream drainages; these effects are representative of a moderate risk of low impacts to flow regime.

The erosion of forest-road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. The *HYDROLOGY ANALYSIS* indicates sediment delivery to the Swan River Face Drainages Analysis Area is expected to be reduced if Action Alternative C is selected. New road construction would not occur near water resources and is expected to present an overall low risk of very low impacts to sediment in the analysis area.

Increased truck traffic can also accelerate the mobilization and erosion of roadbed material at road-stream crossings (*Reid and Dunne 1984*, *Bilby et al 1989*, *Coker et al 1993*, *Luce and Black 2001*). The foreseeable total number of passes by project-related vehicles at all perennial road-stream crossing sites is approximately 16,626. (For analysis details see *SECTION 10* of the document titled *WHITETAIL PORCUPINE EIS, FISHERIES ANALYSIS: SUPPLEMENTAL ANALYSIS DETAILS, 15 MAY 2008* in the project file.) However, through the implementation of project-specific BMPs and road maintenance, the applicable road-stream crossing sites would be expected to deliver most mobilized sediment away from the stream and road prism and filter eroded material through roadside vegetation. These actions are expected to substantially offset the risk of increased sedimentation due to the anticipated levels of project-specific vehicle traffic.

A 100-foot equipment-restriction zone would be implemented adjacent to the terminus (seep) of a non-fish-bearing stream reach, which is expected to reduce potential sediment delivery from ground disturbances related to upland harvesting (*Davies and Nelson 1994*, *Castelle and Johnson 2000*, *Parker 2005*, *Rashin et al 2006*). Application of the SMZ Law is expected to reduce potential sediment delivery from ground disturbances adjacent to perennial and intermittent, non-fish-bearing streams in the analysis area.

Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to the 3 streams from increased project-specific traffic, a net low risk of low impacts to affected fish species and affected fisheries resources (sediment) is expected.

Potential impacts to channel forms are expected to be primarily a function of changes in flow regime and sediment. As a result, a proportional, or low, impact is expected to channel form variables.

Macroinvertebrate richness may decrease slightly due to potential effects to flow regime and sediment (*Herlihy et al 2005*, *VanDusen et al 2005*).

- ***Cumulative Effects of No-Action Alternative A on the Swan River Face Drainages Analysis Area***

The other related past and present factors and site-specific existing conditions described in *EXISTING ENVIRONMENT* would continue to occur. Other future related actions include those described in *CHAPTER 1 – PURPOSE AND NEED* under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS*. These actions include moderate levels of timber harvesting and associated road use on private lands and the potential conversion of forest timberlands to residential use; these actions are expected to have a moderate risk of low impacts to fisheries resources.

Considering all of these impacts collectively, a moderate risk of moderate cumulative impacts is expected to occur. Although the anticipated moderate cumulative effect is a function of all potential related impacts, the elevated cumulative effect in the analysis area is primarily due to adverse impacts from nonnative fish species.

- ***Cumulative Effects of Action Alternatives B and D on the Swan River Face Drainages Analysis Area***

Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from Action Alternatives B and D may cause additional low impacts to multiple fisheries resources. Consequently, a moderate to high risk of moderate cumulative impacts to fisheries resources is expected in the analysis area.

- ***Cumulative Effects of Action Alternative C on the Swan River Face Drainages Analysis Area***

Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from Action Alternative C may cause additional low impacts to multiple fisheries resources. Consequently, a moderate to high risk of moderate cumulative impacts to fisheries resources is expected in the analysis area.

- **UNNAMED TRIBUTARY TO THE PORCUPINE CREEK ANALYSIS AREA**

The proposed actions affecting fisheries resources in the Unnamed Tributary to the Porcupine Creek Analysis Area include:

- use of secondary haul routes for timber and equipment transportation,
- minor road-surface maintenance,
- road construction,
- upland harvesting, and
- riparian harvesting.

No primary point-sources of sediment are expected to occur as a result of the proposed actions. The primary nonpoint-source mechanisms through which fisheries resources are affected by the proposed actions are (1) modifications of flow regime from upland harvesting, (2) sediment delivery from riparian harvesting, and (3) effects to large woody debris and stream temperature from riparian harvesting (see *FIGURE F-5 – DETAIL: UNNAMED TRIBUTARY TO THE PORCUPINE CREEK ANALYSIS AREA*). For analysis in this EIS, flow regime, sediment, channel forms, riparian conditions, large woody debris, stream temperature, and macroinvertebrate richness are the measurable or detectable fisheries resources expected to be potentially affected by the proposed actions.

EXISTING ENVIRONMENT – UNNAMED TRIBUTARY TO THE PORCUPINE CREEK ANALYSIS AREA

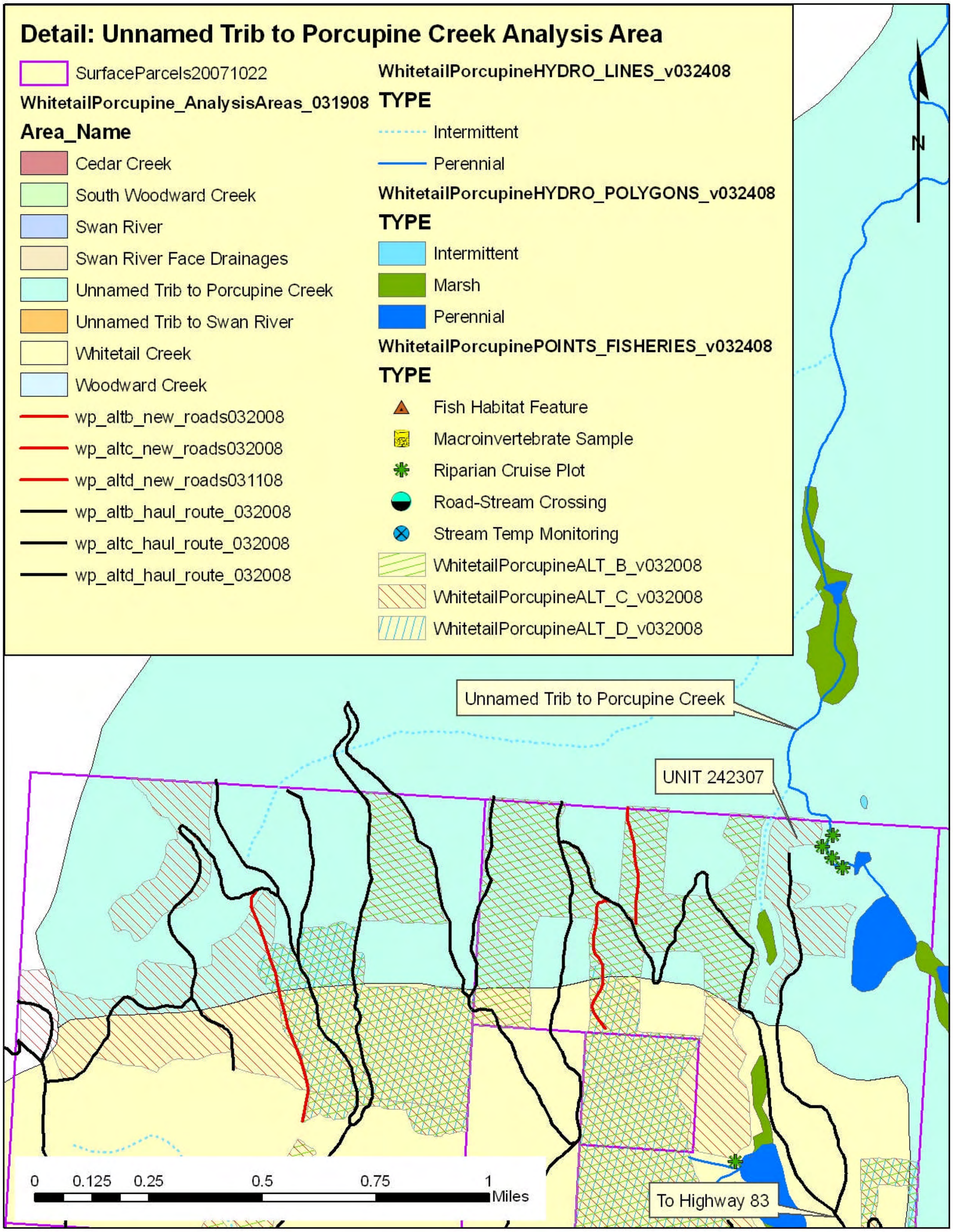
Currently affected fish species in the Unnamed Tributary to the Porcupine Creek Analysis Area are likely limited to eastern brook trout well outside of the project area and in the lower reaches of the watershed, although this is unconfirmed by any DNRC fish biologist or hydrologist surveys. DFWP survey records from *MFISH (2007)* do not indicate any species presence in the analysis area. It is uncertain if native species inhabited the lower reaches of the watershed prior to 'European' settlement.

The quantitative assessment of hydrologic data for this analysis area indicates that the existing average departure in water yield is 6.6 percent above the range of naturally occurring conditions (see *HYDROLOGY ANALYSIS*), which is primarily a result of past forest-crown removal from timber harvesting. The variables of existing peak seasonal flow volume, flow time, and flow duration are expected to be within the range of natural variability.

Quantitative data of percent fine sediment (*McNeil* core), embeddedness (substrate score), or surface substrate size class distribution is not available for any stream reach in the analysis area. The only perennial stream reach in the analysis area is adjacent to proposed unit '242307' (see *FIGURE F-5 – DETAIL: UNNAMED TRIBUTARY TO THE PORCUPINE CREEK ANALYSIS AREA*), which is a stream of very low flow, marginally defined bed and banks, and occasionally disconnected reaches at base flow. Substrates in this stream are expected to be close to 100 percent fine material within the analysis area. Minor amounts of naturally-occurring bank instability were found during 2007. Descriptions of channel type using *Rosgen* (*1996*) or *Montgomery and Buffington (1997*) are not available, but no existing impacts to channel forms in the analysis area are expected.

A quantitative field survey for the *HYDROLOGY ANALYSIS* also indicates fine sediment is not delivered from any road-stream crossing sites in the analysis

FIGURE F-5 – DETAIL: UNNAMED TRIBUTARY TO THE PORCUPINE CREEK ANALYSIS AREA



area. Based on this information, no apparent impacts to sediment in the analysis area are occurring.

Riparian surveys by DNRC specialists during 2007 found the following stand characteristics adjacent to proposed harvest unit '242307':

- average trees per acre = 1,045 (range of 580 to 1,350),
- average quadratic mean diameter (inches) = 8.2 (range of 5.6 to 12.4),
- average basal area (square feet) per acre = 382.4 (range of 199.8 to 512.2),
- estimated average height (feet) of site index trees at 100 years = 75 (estimated range of 40 to 90).

The general width of the functional riparian area (*Hansen et al 1995*) ranges from 30 to approximately 60 feet. Observed rates of riparian vegetation blowdown and stream shading appear normal.

The predominant riparian standtype adjacent to proposed unit '242307' within the analysis area is an unclassified riparian or wetland type of the western red cedar phase (*Hansen et al 1995*). Although western red cedar is typically the dominant species during late seral and climax stages, other species such as grand fir, Engelmann spruce, Douglas-fir, and western larch are also minor components of the overstory. The riparian stand is undetermined as it relates to the associated geology and soils.

Direct measures of large woody debris and in-stream temperatures in the analysis area are not available; however, no conditions were observed in any of the streams that may indicate an atypical range of large woody debris or in-stream temperature.

A quantitative analysis of macroinvertebrate samples and index derivation is not available for the perennial stream adjacent to proposed unit '242307'. No conditions were observed in any of the streams that may indicate a range of macroinvertebrate richness not consistent with the existing stream characteristics.

Based on the above assessment of existing conditions, low existing impacts to flow regime may occur. Other past and present factors affecting the Unnamed Tributary to the Porcupine Creek Analysis Area include those actions described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED*. These other factors include adverse impacts from nonnative fish species, low levels of riparian harvesting, moderate levels of upland harvesting, and timber and equipment hauling by other landowners. These factors, in conjunction with those site-specific existing conditions assessed above, contribute an existing low to moderate collective impact to the Unnamed Tributary to the Porcupine Creek Analysis Area.

ENVIRONMENTAL EFFECTS – UNNAMED TRIBUTARY TO THE PORCUPINE CREEK ANALYSIS AREA

- ***Direct and Indirect Effects of No-Action Alternative A on the Unnamed Tributary to Porcupine Creek Analysis Area***

  No direct or indirect impacts would occur to affected fish species or other affected fisheries resources beyond those described in *EXISTING ENVIRONMENT*.

- ***Direct and Indirect Effects of Action Alternative B on the Unnamed Tributary to the Porcupine Creek Analysis Area***

  The *HYDROLOGY ANALYSIS* indicates the proposed actions related to Action Alternative B are expected to result in a cumulative increase in water yield of 8.3 percent in the analysis area. The expected increase in water yield is 1.7 percent above the existing condition. Peak seasonal flow volumes may be slightly greater, peak seasonal flow time may be slightly earlier, and peak seasonal flow duration may be slightly longer. However, these expected minor departures in flow regime are not likely to have detectable or otherwise measurable effects to fisheries resources in the analysis area, and these effects are representative of a moderate risk of very low impacts to flow regime.

  The erosion of forest-road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates no sediment delivery is expected to the streams in the analysis area if Action Alternative B is selected. New road construction would not occur near water resources and is expected to present an overall low risk of very low impacts to sediment in the analysis area. Project-related traffic would not cross any perennial streams.

  A 50-foot equipment-exclusion zone would be implemented along 1 intermittent stream in the analysis area, which is expected to reduce potential sediment delivery from ground disturbances related to upland harvesting (*Davies and Nelson 1994*, *Castelle and Johnson 2000*, *Parker 2005*, *Rashin et al 2006*). Application of the SMZ Law is expected to reduce potential sediment delivery from ground disturbances adjacent to the intermittent, non-fish-bearing stream.

  Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to water resources from upland harvesting, a net low risk of very low impacts to affected fish species and affected fisheries resources (sediment) is expected.

  Potential impacts to channel forms are expected to be primarily a function of changes in flow regime and sediment. As a result, a proportional, or very low, impact is expected to all channel-form variables.

  The downstream fisheries resources of riparian conditions, large woody debris, and stream temperature are not expected to be affected by the proposed actions, since Action Alternative B only includes potential riparian harvesting up to 50 feet away from a 1,050-foot segment of a non-fish-bearing, intermittent stream. Application of the SMZ Law is expected to reduce potential effects to stream temperature in intermittent, non-fish-bearing streams in the analysis area.

  No measurable or detectable effects to macroinvertebrate richness in downstream fish-bearing reaches are expected from riparian harvesting along 1 intermittent stream. Macroinvertebrate richness may decrease slightly due to potential effects to flow regime and sediment (*Herlihy et al 2005*, *VanDusen et al 2005*).

- ***Direct and Indirect Effects of Action Alternative C on the Unnamed Tributary to the Porcupine Creek Analysis Area***

  The *HYDROLOGY ANALYSIS* indicates the proposed actions related to Action Alternative C are expected to result in a cumulative increase in water yield of 10.1 percent in the analysis area. The expected increase in water yield is 3.5 percent above the existing condition. Peak seasonal flow volumes may be slightly greater, peak seasonal flow time may be slightly earlier, and peak seasonal flow duration may be slightly longer. These expected minor departures in flow regime may have detectable or otherwise measurable effects to fisheries resources in the analysis area, and these effects are representative of a moderate risk of low impacts to flow regime.

  The erosion of forest-road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road-surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates no sediment delivery is expected to the streams in the analysis area if Action Alternative C is selected. New road construction would not occur near water resources and is expected to present an overall low risk of very low impacts to sediment in the analysis area. Project-related traffic would not cross any perennial streams.

  A 50- to 100-foot equipment-exclusion zone would be implemented along 1 intermittent stream and 1 perennial stream in the analysis area, which is expected to reduce potential sediment delivery from ground disturbances related to upland harvesting (*Davies and Nelson 1994*, *Castelle and Johnson 2000*, *Parker 2005*, *Rashin et al 2006*). Application of the SMZ Law is expected to reduce potential sediment delivery from ground disturbances adjacent to perennial and intermittent, non-fish-bearing streams in the analysis area.

  Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to water resources from upland harvesting, a net low risk of very low impacts to affected fish species and affected fisheries resources (sediment) is expected.

  Potential impacts to channel forms are expected to be primarily a function of changes in flow regime and sediment. As a result, a proportional, or very low, impact is expected to all channel form variables.

  The downstream fisheries resources of riparian conditions, large woody debris, and stream temperature are not expected to be affected by the proposed actions, since Action Alternative C only includes potential riparian harvesting up to 50 feet away from a 1,050-foot segment of a non-fish-bearing, intermittent stream and up to 100 feet away from a 1,100-foot segment of a non-fish- bearing, perennial stream. Implementation of a 100-foot wide, no-harvest zone along the single perennial stream is expected to greatly reduce potential effects to stream temperature as a result of potential changes to the riparian condition (*Beschta et al 1987*, *Brosofske et al 1997*, *Wilkerson et al 2006*). Application of the SMZ Law is expected to reduce potential effects to stream temperature in perennial and intermittent, non-fish-bearing streams in the analysis area.

No measurable or detectable effects to macroinvertebrate richness in downstream fish-bearing reaches are expected from riparian harvesting along 1 intermittent stream and 1 perennial stream. Macroinvertebrate richness may decrease slightly due to potential effects to flow regime and sediment (*Herlihy et al 2005*, *VanDusen et al 2005*).

- ***Direct and Indirect Effects of Action Alternative D on the Unnamed Tributary to the Porcupine Creek Analysis Area***

The *HYDROLOGY ANALYSIS* indicates the proposed actions related to Action Alternative D are expected to result in the existing cumulative increase in water yield of 6.6 percent in the analysis area. Under this alternative, no increase in water yield is expected above the existing condition. Peak seasonal flow volumes, peak seasonal flow time, and peak seasonal flow duration are not expected to change. No impacts to flow regime are expected to occur.

The erosion of forest-road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates no sediment delivery is expected to the streams in the analysis area if Action Alternative D is selected. New road construction would not occur near water resources and is expected to present an overall low risk of very low impacts to sediment in the analysis area. Project-related traffic would not cross any perennial streams.

Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, no impacts to affected fish species and affected fisheries resources (sediment) is expected.

Potential impacts to channel forms are expected to be primarily a function of changes in flow regime and sediment. As a result, no impacts to channel-form variables are expected.

The downstream fisheries resources of riparian conditions, large woody debris, and stream temperature are not expected to be affected by the proposed actions, since Action Alternative D does not include any potential riparian harvesting along any streams.

No measurable or detectable effects to macroinvertebrate richness in downstream fish-bearing reaches are expected.

- ***Cumulative Effects of No-Action Alternative A on the Unnamed Tributary to the Porcupine Creek Analysis Area***

  The other related past and present factors and site-specific existing conditions described in *EXISTING ENVIRONMENT* would continue to occur. Other future related actions include those described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED* and the low levels of timber harvesting and associated road use on other land ownerships; these actions are expected to have a low risk of low impacts to fisheries resources. Considering all of these impacts collectively, a moderate risk of low to moderate cumulative impacts is expected to occur. Although the anticipated low to moderate cumulative effect is a function of all potentially related impacts, the elevated cumulative effect in the analysis area is primarily due to adverse impacts from nonnative fish species.

- ***Cumulative Effects of Action Alternatives B and C on the Unnamed Tributary to the Porcupine Creek Analysis Area***

  Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from Action Alternatives B and C may cause additional low impacts to fisheries resources. Consequently, a moderate risk of low to moderate cumulative impacts to fisheries resources is expected in the analysis area.

- ***Cumulative Effects of Action Alternative D on the Unnamed Tributary to the Porcupine Creek Analysis Area***

  Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from Action Alternative D are not expected to cause additional impacts to fisheries resources. Consequently, a moderate risk of low to moderate cumulative impacts to fisheries resources is expected in the analysis area.

➢ UNNAMED TRIBUTARY TO THE SWAN RIVER ANALYSIS AREA

The proposed actions affecting fisheries resources in the Unnamed Tributary to the Swan River Analysis Area include use of a major haul route for timber and equipment transportation and minor road-surface maintenance. The point-source mechanism through which fisheries resources are affected by the proposed actions is sediment delivery to fish habitats at a single road-stream crossing (see *FIGURE F-2 – DETAIL: CEDAR CREEK, SWAN RIVER, AND UNNAMED TRIBUTARY TO THE SWAN RIVER ANALYSIS AREA*). For analysis in this EIS, sediment is the only measurable or detectable fisheries resource expected to be potentially affected by the proposed actions.

EXISTING ENVIRONMENT – UNNAMED TRIBUTARY TO THE SWAN RIVER ANALYSIS AREA

The Unnamed Tributary to Swan River is an intermittent and seasonally warm stream. Based on field review of the intermittent Unnamed Tributary to Swan River by DNRC hydrologists, the only potentially affected fish species in the analysis area is eastern brook trout.

Quantitative data of percent fine sediment (*McNeil* core), embeddedness (substrate score), or surface substrate size-class distribution is not available for the stream reach adjacent to the proposed road-stream crossing site. Field reviews during 2007 by DNRC hydrologists indicate a normal distribution of substrate size classes is likely in the stream reach adjacent to the proposed road-stream crossing site.

The existing culvert at the road-stream crossing is at a low risk of failure during high-flow events. A qualitative field survey for the *HYDROLOGY ANALYSIS* indicates an existing low risk of sediment delivery to the Unnamed Tributary to Swan River at the road-stream crossing site. Based on this information, a low impact to sediment is likely occurring in the Unnamed Tributary to Swan River, but the existing condition is also likely to be within the expected range of variability found in the stream reach.

Other past and present factors affecting the Unnamed Tributary to the Swan River Analysis Area include those actions described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED*. These other factors include adverse impacts from nonnative fish species, low levels of upland harvesting, and timber and equipment hauling by other landowners. These other factors, in conjunction with those site-specific existing conditions assessed above, contribute an existing low to moderate collective impact to the Unnamed Tributary to the Swan River Analysis Area.

ENVIRONMENTAL EFFECTS – UNNAMED TRIBUTARY TO THE SWAN RIVER ANALYSIS AREA

- ***Direct and Indirect Effects of No-Action Alternative A on the Unnamed Tributary to the Swan River Analysis Area***

  No direct or indirect impacts would occur to affected fish species or other affected fisheries resources beyond those described in *EXISTING ENVIRONMENT*.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D on the Unnamed Tributary to the Swan River Analysis Area***

  The erosion of forest road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates sediment delivery to the Unnamed Tributary to Swan River is expected to be reduced if any of the 3 action alternatives are selected.

  The assessment of potential impacts to the Unnamed Tributary to the Swan River Analysis Area is expected to be similar to that of the Cedar Creek Analysis Area in that the proposed actions of all of the action alternatives are the same for both analysis areas. Although the Unnamed Tributary to the Swan River and Cedar Creek road-stream crossing structures are different, both function similarly by diverting most mobilized sediment away from the stream and road prism and filtering eroded material through roadside vegetation.

Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to the Unnamed Tributary to Swan River from increased project-specific traffic, a net low risk of low impacts to affected fish species and affected fisheries resources (sediment) is expected.

- ***Cumulative Effects of No-Action Alternative A on the Unnamed Tributary to the Swan River Analysis Area***

The other related past and present factors and site-specific existing conditions described in *EXISTING ENVIRONMENT* would continue to occur. Other future related actions include those described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED* and potential conversion of forest timberlands to residential use; these actions are expected to have a low risk of low impacts to fisheries resources. Considering all of these impacts collectively, a moderate risk of low to moderate cumulative impacts is expected to occur. Although the anticipated low to moderate cumulative effect is a function of all potentially related impacts, the elevated cumulative effect in the analysis area is primarily due to adverse impacts from nonnative fish species.

- ***Cumulative Effects of Action Alternatives B, C, and D on the Unnamed Tributary to the Swan River Analysis Area***

Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from all action alternatives may cause an additional risk of impact to fisheries resources. Consequently, a moderate risk of low to moderate cumulative impacts to fisheries resources is expected in the analysis area.

WHITETAIL CREEK ANALYSIS AREA

The proposed actions affecting fisheries resources in the Whitetail Creek Analysis Area include:

- use of a major haul routes for timber and equipment transportation,
- minor road surface maintenance,
- road construction, including culvert replacement,
- upland harvesting, and
- riparian harvesting.

The primary point-source mechanism through which fisheries resources are affected by the proposed actions is sediment delivery to fish habitats at 7 road crossings of perennial stream reaches (see *FIGURE F-6 – DETAIL: WHITETAIL CREEK ANALYSIS AREA*). The primary nonpoint-source mechanisms through which fisheries resources are affected by the proposed actions are (1) modifications of flow regime from upland harvesting, (2) sediment delivery from riparian harvesting, and (3) effects to large woody debris and stream temperature from riparian harvesting. For analysis in this EIS, population, flow regime, sediment, channel forms, riparian conditions, large woody debris, stream temperature, macroinvertebrate richness, and connectivity are the measurable or detectable fisheries resources expected to be potentially affected by the proposed actions.

Although connectivity at Site 360 (see *FIGURE F-6 – DETAIL: WHITETAIL CREEK ANALYSIS AREA*) is impaired, no proposed actions would affect this variable at this road-stream crossing; therefore, an effects assessment is not needed for this particular resource.

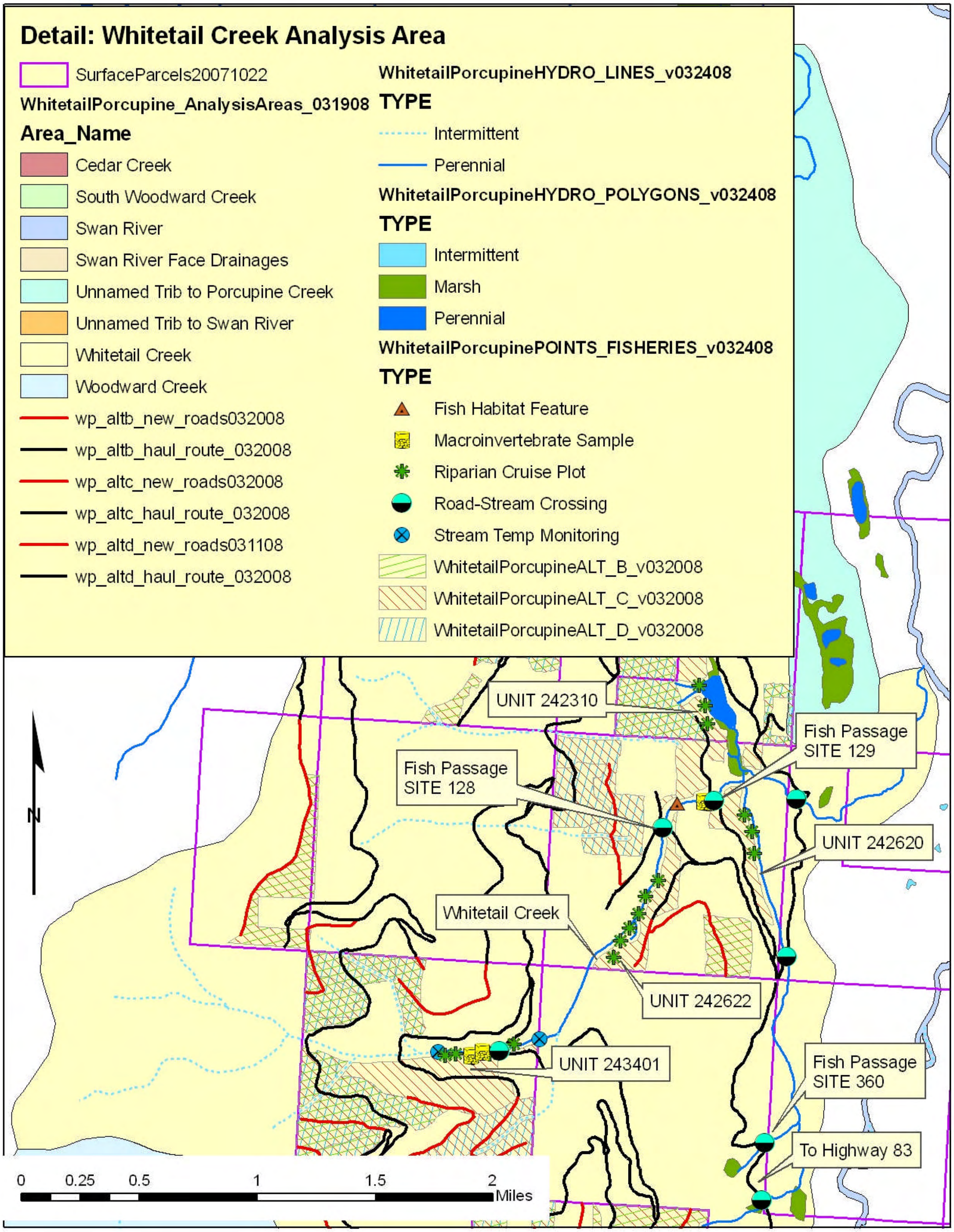
EXISTING ENVIRONMENT – WHITETAIL CREEK ANALYSIS AREA

Affected fish species in the Whitetail Creek Analysis Area include westslope cutthroat trout and eastern brook trout (*MFISH 2007*). Surveys by DFWP have identified an isolated and genetically pure population of westslope cutthroat trout upstream of a natural migration barrier between 'Fish Passage Sites 128 and 129' (see *FIGURE F-6 – DETAIL: WHITETAIL CREEK ANALYSIS AREA*). Downstream of the natural migration barrier, the remaining Whitetail Creek drainage very likely contained westslope cutthroat trout, bull trout, and sculpin during presettlement. Fish presence/ absence surveys by a DNRC fish biologist during 2007 identified approximately 3 miles of tributary streams connected to Whitetail Creek below the natural migration barrier where eastern brook trout have displaced native westslope cutthroat trout and bull trout. For the purposes of this environmental assessment, Whitetail Creek below the natural migration barrier will be considered westslope cutthroat trout and bull trout habitat. The complete displacement of native westslope cutthroat trout and bull trout by eastern brook trout below the natural migration barrier is representative of a high existing impact to native species population presence.

The analysis of hydrologic data for Whitetail Creek indicates that the existing average departure in water yield is approximately 7.4 percent above the range of naturally occurring conditions (see *HYDROLOGY ANALYSIS*), which is primarily a result of past forest-crown removal from timber harvesting. The variables of existing peak seasonal flow volume, flow time, and flow duration are expected to be within the range of natural variability.

A 2007 measurement of percent fine sediment (*McNeil* core) upstream of the natural migration barrier was 38.1 percent (*T. Weaver, DFWP Kalispell*). A quantitative measure of embeddedness (substrate score) is not available. Measurements of surface substrate fine sediment (0 to 8 millimeters) are 95 percent in the reach below 'Fish Passage Site 129' (C channel type) and range from 43 to 56 percent above 'Fish Passage Site 129' (B channel type) (*Sawtelle 2006*). The percent fine sediment of 38.1 percent may indicate a condition that is marginally acceptable to threatening for native species embryo survival (*FBC 1991*). The Whitetail Creek reaches exhibiting C5 channel-type morphologies have a measure of surface substrate fine sediment within the expected range for that channel type (*Rosgen 1996*). The Whitetail Creek reaches exhibiting B4 channel-type morphologies have

FIGURE F-6 – DETAIL: WHITETAIL CREEK ANALYSIS AREA



measures of surface substrate fine sediment above the expected average of 33 percent for that channel type (*Rosgen 1996*). Although the reaches of Whitetail Creek upstream of the 'Fish Passage Site 129' exhibit elevated levels of percent fine sediment (*McNeil* core) and surface substrate fine sediment (0 to 8 millimeters), the measures are not necessarily unexpected due to the stable, spring-fed-dominated flow regime of the stream.

The existing structures at the 7 road-stream crossings include 3 bridges and 4 culverts, most of which are at a low risk of failure during high-flow events. The bridge over lower Whitetail Creek is at moderate risk of failure during high-flow events. A quantitative field survey for the *HYDROLOGY ANALYSIS* indicates approximately 5.9 tons per year of fine sediment is delivered to the Whitetail Creek Analysis Area from all road-stream crossing sites. Based on this information, a low impact to sediment is likely occurring in Whitetail Creek, but the existing condition is also likely to be within the expected range of variability found in the stream reach.

Channel forms range from pool/riffle and plane bed adjacent to proposed harvest units '242310' and '242620' to step/pool and cascade adjacent to proposed harvest units '243401' and '242622' (*Montgomery and Buffington 1997*) (see *FIGURE F-6 – DETAIL: WHITETAIL CREEK ANALYSIS AREA*). Throughout the C5 channel-type (lower) reaches, 'slow' habitat features (*Overton et al 1997*) comprise approximately 84 percent of the stream area and approximately 93 percent of the stream volume (*Sawtelle 2006*). The B4 channel-type (upper) reaches have 'slow' habitat features (*Overton et al 1997*) comprising 12 to 18 percent of the stream area and 20 to 27 percent of the stream volume (*Sawtelle 2006*). Over 99 percent of all channel banks were observed to be stable (*Overton et al 1997*, *Sawtelle 2006*). These channel-form variables are within the expected range of other observations (of primarily undisturbed stream reaches) in Swan River State Forest.

TABLE F-4 – WHITETAIL CREEK ANALYSIS AREA – RIPARIAN CONDITIONS describes riparian stand characteristics adjacent to potentially affected harvest units. The riparian surveys were conducted by a DNRC fish biologist and hydrologist during 2007. Most riparian stand characteristics are within expected ranges, except for the amount of basal area per acre and quadratic mean diameter adjacent to proposed harvest units '242310' and '242620'. These 2 variables are lower than expected and are indicative of past moderate levels of riparian harvesting. This condition is representative of a low to moderate existing impact to the riparian condition adjacent to the 2 proposed harvest units.

The predominant riparian stand type adjacent to proposed harvest units '242310' and '242620' is western red cedar/oak fern. Although western red cedar is typically the dominant species during late seral and climax stages, other species such as grand fir, Engelmann spruce, Douglas-fir, and western larch are also major components of the overstory (*Hansen et al 1995*). The predominant riparian stand types adjacent to proposed harvest units

TABLE F-4 – WHITETAIL CREEK ANALYSIS AREA – RIPARIAN CONDITIONS

ADJACENT PROPOSED HARVEST UNIT	TREES PER ACRE, AVERAGE	TREES PER ACRE, RANGE	BASAL AREA PER ACRE (SQUARE FEET), AVERAGE	BASAL AREA PER ACRE (SQUARE FEET), RANGE	QUADRATIC MEAN DIAMETER, AVERAGE	QUADRATIC MEAN DIAMETER, RANGE	ESTIMATED RATES OF BLOWDOWN
242310	457	100 to 860	125.6	55.8 - 210.9	7.1	4.8 - 19.7	Normal
242620	1,013	320 to1,360	101.4	58.5 - 127.7	4.3	2.8 - 8.2	Normal
242622	797	300 to 1,250	391.6	254.6 - 587.1	9.5	8.5 - 10.5	Normal
243401	317	190 to 400	340.4	164.7 - 570.7	14.0	10.4 - 16.8	Normal
ADJACENT PROPOSED HARVEST UNIT	**ANGULAR CANOPY DENSITY (PERCENT SHADE), AVERAGE, JULY**	**ANGULAR CANOPY DENSITY (PERCENT SHADE), RANGE, JULY**	**ANGULAR CANOPY DENSITY (PERCENT SHADE), AVERAGE, AUG**	**ANGULAR CANOPY DENSITY (PERCENT SHADE), RANGE, AUG**	**SITE INDEX TREE HEIGHT AT 100 YEARS, AVERAGE**	**SITE INDEX TREE HEIGHT AT 100 YEARS, RANGE**	**NUMBER OF RIPARIAN CRUISE PLOTS**
242310	72	66 to 76	74	68 to 85	67	40 to 81	3
242620	54	48 to 61	64	56 to 73	46	33 to 63	3
242622	91	83 to 96	94	88 to 100	64	35 to 86	6
243401	89	82 to 97	93	78 to 100	71	63 to 79	6

'242622' and '243401' are western red cedar/devil's club with lesser amounts of western red cedar/lady fern. Although western red cedar is typically the dominant species during late seral and climax stages, other species such as western hemlock, grand fir, and Engelmann spruce are also major components of these overstories (*Hansen et al 1995*). The riparian stand as it relates to the associated geology and soils can be classified as exhibiting SL2B characteristics, which primarily occurs adjacent to B and C channel types with stream gradients ranging from 1 to 12 percent (*Sirucek and Bachurski 1995*). Where the SL2B riparian landtype occurs with the stand characteristics described above, expected conditions are somewhat poorly drained sites with deep, weakly developed, gravelly or bouldery, sandy loams or loams (*Sirucek and Bachurski 1995*).

Large woody debris surveys of the C channel type (lower) reaches of Whitetail Creek found an average of 59 pieces of large woody debris (*Overton et al 1997*) per 1,000 feet of stream (*Sawtelle 2006*). Large woody debris surveys for Whitetail Creek adjacent to proposed harvest units '242622' and '243401' found a range of 116 to 134 pieces of large woody debris (*Overton et al 1997*) per 1,000 feet of stream (*Sawtelle 2006*). Data from reference reaches (*Harrelson et al 1994*) throughout the Flathead River Basin region indicate that the average expected large woody debris counts (pieces per 1,000 feet) in undisturbed C and B channels are 61 (range: 1 to 121) and 123 (range: 74 to 172), respectively (*Bower 2006*). This data suggests that the existing frequencies of large woody debris adjacent to the potentially affected areas are within the expected range of frequencies when compared to reference reaches in the region with similar morphological characteristics.

A detailed assessment of in-stream temperature was conducted during spring through fall of 2007. Continuous data collected from 3 sensor locations (see *FIGURE F-6 – DETAIL: WHITETAIL CREEK ANALYSIS AREA*) found an average in-stream temperature rate of change equal to +0.80 degrees Celsius per 1,000 stream feet (range: +0.74 to +0.85 degrees Celsius per 1,000 stream feet). The peak seasonal mean weekly maximum temperatures at the upper (spring head) and lower temperature sensor were 4.4 and 10.2 degrees Celsius, respectively. These direct measurements are consistent with spring-fed-dominated flow regimes in Swan River State Forest.

An analysis was conducted of 2 separate replicate macroinvertebrate samples taken from Whitetail Creek during August 2007 (see *FIGURE F-6 – DETAIL: WHITETAIL CREEK ANALYSIS AREA*). Analysis of samples adjacent to proposed harvest unit '243401' indicate an "unimpaired" to "slight impairment" stream condition according to DEQ and historic macroinvertebrate indexes, respectively (*Bollman 2008*). This result, due to low overall taxa richness, may be a function of elevated sediment deposition and monotonous habitats (*Bollman 2008*), which are at least partly consistent with the stable, spring-fed-dominated flow regime of the stream and monocultural characteristics of the adjacent riparian area (i.e. low variability in trees per acre, angular canopy density, and site index tree height at 100 years; see *TABLE F-4 – WHITETAIL CREEK ANALYSIS AREA – RIPARIAN CONDITIONS*). Analysis of the samples just upstream of 'Fish Passage Site 129' indicates an "unimpaired" stream condition according to DEQ and historic macroinvertebrate indexes (*Bollman 2008*).

Quantitative survey results of native fisheries connectivity indicate 'Fish Passage Site 128' provides passage for all adult fish, but not juvenile life stages. Survey results from 'Fish Passage Site 129' indicate the road-stream crossing structure is a passage barrier to all adult and juvenile life stages at all flows. These conditions represent a moderate to high existing impact to connectivity.

Other past and present factors affecting the Whitetail Creek Analysis Area include those actions described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED* adverse impacts from nonnative fish species, moderate levels of riparian harvesting, moderate levels of upland harvesting, timber and equipment hauling by other landowners, and other publicly open road-stream crossing sites. These other factors, in conjunction with those site-specific existing conditions assessed above, contribute an existing moderate collective impact to the Whitetail Creek Analysis Area.

ENVIRONMENTAL EFFECTS – WHITETAIL CREEK ANALYSIS AREA

- ***Direct and Indirect Effects of No-Action Alternative A on the Whitetail Creek Analysis Area***

No direct or indirect impacts would occur to affected fish species or other affected fisheries resources beyond those described in *EXISTING ENVIRONMENT*.

- ***Direct and Indirect Effects of Action Alternative B on the Whitetail Creek Analysis Area***

The analysis of effects to population variables will be discussed at the end of this section in conjunction with connectivity.

The *HYDROLOGY ANALYSIS* indicates the proposed actions related to Action Alternative B are expected to result in a cumulative increase in water yield of 12.0 percent in Whitetail Creek. The expected increase in water yield is 4.6 percent above the existing condition. Peak seasonal flow volumes may be slightly greater, peak seasonal flow time may be slightly earlier, and peak seasonal flow duration may be slightly longer. These expected departures in flow regime may have detectable or otherwise measurable effects to fisheries resources in Whitetail Creek, and these effects are representative of a moderate risk of low impacts to flow regime.

The erosion of forest road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates a 76-percent reduction in sediment delivery to Whitetail Creek is expected if Action Alternative B is selected. New road construction would occur near water resources (approximately 2,000 total feet of new road within 300 feet of 3 intermittent streams) and is expected to present an overall low risk of low impacts to sediment in Whitetail Creek; a low risk is expected due to the extent of vegetated buffers adjacent to the proposed new roads and potential sediment-delivery distances to Whitetail Creek. The replacement of road-stream crossing structures at 'Fish Passage Sites 128 and 129' and the Whitetail Creek bridge will cause short-term delivery at both sites (high risk of moderate short-term impacts); however, long-term risks of impacts to sediment at both sites are expected to be low.

Increased truck traffic can also accelerate the mobilization and erosion of roadbed material at road-stream crossings (*Reid and Dunne 1984, Bilby et al 1989, Coker et al 1993, Luce and Black 2001*). The foreseeable total number of passes by project-related vehicles at all perennial road-stream crossing sites is approximately 10,340. (For analysis details see *SECTION 6* of the document titled *WHITETAIL PORCUPINE EIS, FISHERIES ANALYSIS: SUPPLEMENTAL ANALYSIS DETAILS, 15 MAY 2008* in the project file.) However, through the implementation of project-specific BMPs and road maintenance, the applicable road-stream crossing sites would be expected to deliver most mobilized sediment away from the stream and road prism, and filter eroded material through roadside vegetation. These actions are expected to substantially offset the risk of increased sedimentation due to the anticipated levels of project-specific vehicle traffic.

A 100-foot equipment-exclusion zone would be implemented along tributaries to Whitetail Creek adjacent to proposed harvest units '242317' and '230221', which is expected to greatly reduce potential sediment delivery from ground disturbances related to upland harvesting (*Davies and Nelson 1994*, *Castelle and Johnson 2000*, *Parker 2005*, *Rashin et al 2006*). Application of the SMZ Law is expected to reduce potential sediment delivery from ground disturbances adjacent to perennial and intermittent, non-fish-bearing streams in the analysis area.

Considerations for impacts to sediment include: a positive impact due to the implementation of project-specific BMPs and road maintenance, a risk of fine sediment delivery to Whitetail Creek from increased project-specific traffic and new road construction, and a high risk of moderate short-term impacts from 3 road-stream-crossing structure replacements. A net high risk of moderate impacts is expected in the short term, and a low risk of low impacts to affected fish species and affected fisheries resources is expected in the long term.

Potential impacts to channel forms are expected to be primarily a function of (long term) changes in flow regime and sediment. As a result, a proportional, or low, impact is expected to all channel form variables.

A 100-foot wide, no-harvest zone would be implemented along tributaries to Whitetail Creek adjacent to proposed harvest units '242317' and '230221'. As a result of the proposed action, riparian stand characteristics and habitat types are not expected to be affected. Due to hydrologic and soil features associated with the riparian habitat type, the rate of riparian tree blowdown may increase (*Hansen et al 1995, Sirucek and Bachurski 1995*). Scientific literature reviews (*Belt et al 1992, McGreer 1994, Castelle and Johnson 2000*) suggest a no-harvest zone of this extent is expected to greatly reduce potential upland harvesting effects to in-stream shading.

Considering riparian stand characteristics and the implementation of a 100-foot wide, no-harvest zone, potential impacts to large woody debris in Whitetail Creek are expected to be greatly reduced; this assessment is based on similar observations from other related studies (*Murphy and Koski 1989*, *McDade et al 1990*, *Robinson and Beschta 1990*, *Van Sickle and Gregory 1990*).

The mean weekly maximum stream temperature may increase slightly due to potential effects to flow regime and sediment. Implementation of a 100-foot wide, no-harvest zone along tributaries to Whitetail Creek is expected to greatly reduce potential effects to stream temperature as a result of potential changes to riparian condition (*Beschta et al 1987*, *Brosofske et al 1997*, *Wilkerson et al 2006*). Application of the SMZ Law is expected to reduce potential effects to stream temperature in perennial and intermittent, non-fish-bearing streams in the analysis area.

Macroinvertebrate richness may decrease slightly due to potential effects to flow regime and sediment (*Herlihy et al 2005, VanDusen et al 2005*). Implementation of a 100-foot wide, no-harvest zone is expected to reduce potential positive or adverse effects to macroinvertebrate richness as a result of potential changes to riparian condition (*Newbold et al 1980*, *Carlson et al 1990*, *Moldenke and Ver Linden 2007*).

A low risk of low adverse impacts to riparian condition, large woody debris, stream temperature, and macroinvertebrate richness is expected as a result of implementing Action Alternative B.

'Fish Passage Site 128' would be rebuilt with an embedded culvert designed to emulate streambed form and function within the structure. This action will have a positive impact to native fisheries connectivity by enabling the normal passage of all adult and juvenile westslope cutthroat trout at all seasonal flows. 'Fish Passage Site 129' would be rebuilt with a new culvert designed to be a barrier to all fish at all flows.

Compared to the existing condition, this action will have no change to fisheries connectivity at the site.

After the installation of a new barrier at 'Fish Passage Site 129', DNRC specialists would remove any nonnative fish species between the new barrier and the natural migration barrier approximately 800 feet upstream. Removed nonnative fish would be transported downstream of the new barrier at 'Fish Passage Site 129', and this action would be conducted through collaboration with DFWP. This action is expected to provide more habitats to the isolated and genetically pure population of westslope cutthroat trout in Whitetail Creek. The new habitat, which would be free of nonnative fish, is expected to reduce long-term risks to the westslope cutthroat trout population by allowing an increase in the number of genetically pure fish and decreasing population risks from natural events (positive effect).

- ***Direct and Indirect Effects of Action Alternative C on the Whitetail Creek Analysis Area***

The analysis of effects to population variables will be discussed at the end of this section in conjunction with connectivity.

The *HYDROLOGY ANALYSIS* indicates the proposed actions related to Action Alternative C are expected to result in a cumulative increase in water yield of 13.9 percent in Whitetail Creek. This increase in water yield is over a threshold of 12 percent, which may indicate an elevated risk of adverse impacts to flow regime and sediment-related fisheries resources. The expected increase in water yield is 6.5 percent above the existing condition. Peak seasonal flow volumes may be slightly greater, peak seasonal flow time may be slightly earlier, and peak seasonal flow duration may be slightly longer. These expected departures in flow regime may have detectable or otherwise measurable effects to fisheries resources in Whitetail Creek, and these effects are representative of a moderate to high risk of low impacts to flow regime.

The erosion of forest-road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates an 80-percent reduction in sediment delivery to Whitetail Creek is expected if Action Alternative C is selected. New road construction would occur near water resources (approximately 3,600 total feet of new road within 300 feet of 4 intermittent streams) and is expected to present an overall low risk of low impacts to sediment in Whitetail Creek; a low risk is expected due the extent of vegetated buffers adjacent to the proposed new roads and potential sediment delivery distances to Whitetail Creek. The replacement of road-stream crossing structures at 'Fish Passage Sites 128 and 129' and the Whitetail Creek bridge will cause short-term delivery at both sites (high risk of moderate short-term impacts); however, long-term risks of impacts to sediment at both sites are expected to be low.

Increased truck traffic can also accelerate the mobilization and erosion of roadbed material at road-stream crossings (*Reid and Dunne 1984, Bilby et al 1989, Coker et al 1993, Luce and Black 2001*). The foreseeable total number of passes by project-related vehicles at all perennial road-stream crossing sites is approximately 20,650. [For analysis details, see *SECTION 7* of the document titled *WHITETAIL PORCUPINE EIS, FISHERIES ANALYSIS: SUPPLEMENTAL ANALYSIS DETAILS, 15 MAY 2008* in the project file.] However, through the implementation of project-specific BMPs and road maintenance, the applicable road-stream crossing sites would be expected to deliver most mobilized sediment away from the stream and road prism and filter eroded material through roadside vegetation. These actions are expected to substantially offset the risk of increased sedimentation due to the anticipated levels of project-specific vehicle traffic.

A 100-foot equipment-exclusion zone would be implemented along Whitetail Creek and tributaries adjacent to proposed harvest units '242310', '242620', '243401', '242622', '242317', and 230221', which is expected to greatly reduce potential sediment delivery from ground disturbances related to upland harvesting (*Davies and Nelson 1994, Castelle and Johnson 2000, Parker 2005, Rashin et al 2006*). Application of the SMZ Law is expected to reduce potential sediment delivery from ground disturbances adjacent to perennial and intermittent non-fish-bearing streams in the analysis area.

Considerations for impacts to sediment include a positive impact due to the implementation of project-specific BMPs and road maintenance, a moderate risk of fine sediment delivery to Whitetail Creek from increased project-specific traffic and new road construction, and a high risk of moderate short-term impacts from 3 road-stream-crossing structure replacements. A net high risk of moderate impacts is expected in the short term, and a low risk of low impacts to affected fish species and affected fisheries resources is expected in the long term.

Potential impacts to channel forms are expected to be primarily a function of (long-term) changes in flow regime and sediment. As a result, a proportional, or low, impact is expected to all channel-form variables.

A 100-foot wide, no-harvest zone would be implemented along tributaries to Whitetail Creek adjacent to proposed harvest units '242310', '242620', '243401', '242622', '242317', and 230221'. As a result of the proposed action, riparian stand characteristics and habitat types are not expected to be affected. Due to hydrologic and soil features associated with the riparian habitat type, the rate of riparian tree blowdown may increase (*Hansen et al 1995, Sirucek and Bachurski 1995*). Scientific literature reviews (*Belt et al 1992, McGreer 1994, Castelle and Johnson 2000*) suggest a no-harvest zone of this extent is expected to greatly reduce potential upland harvest effects to in-stream shading.

Considering riparian stand characteristics and the implementation of a 100-foot wide, no-harvest zone, potential impacts to large woody debris in Whitetail Creek are expected to be greatly reduced; this assessment is based on similar observations from other related studies (*Murphy and Koski 1989*, *McDade et al 1990*, *Robinson and Beschta 1990*, *Van Sickle and Gregory 1990*).

Mean weekly maximum stream temperature may increase slightly due to potential effects to flow regime and sediment. Implementation of a 100-foot wide, no-harvest zone along Whitetail Creek and tributaries is expected to greatly reduce potential effects to stream temperature as a result of potential changes to the riparian condition (*Beschta et al 1987*, *Brosofske et al 1997*, *Wilkerson et al 2006*). The application of the SMZ Law is expected to reduce potential effects to stream temperature in perennial and intermittent, non-fish-bearing streams in the analysis area.

Macroinvertebrate richness may decrease slightly due to potential effects to flow regime and sediment (*Herlihy et al 2005*, *VanDusen et al 2005*). Implementation of a 100-foot wide, no-harvest zone is expected to reduce potential positive or adverse effects to macroinvertebrate richness as a result of potential changes to the riparian condition (*Newbold et al 1980*, *Carlson et al 1990*, *Moldenke and Ver Linden 2007*).

A low risk of low adverse impacts to the riparian condition, large woody debris, stream temperature, and macroinvertebrate richness is expected as a result of implementing Action Alternative C.

Effects to connectivity and populations would be the same as those described for Action Alternative B.

- ***Direct and Indirect Effects of Action Alternative D on the Whitetail Creek Analysis Area***

The analysis of effects to population variables will be discussed at the end of this section in conjunction with connectivity.

The *HYDROLOGY ANALYSIS* indicates the proposed actions related to Action Alternative D are expected to result in a cumulative increase in water yield of 11.4 percent in Whitetail Creek. The expected increase in water yield is 4.0 percent above the existing condition. Peak seasonal flow volumes may be slightly greater, peak seasonal flow time may be slightly earlier, and peak seasonal flow duration may be slightly longer. These expected departures in flow regime may have detectable or otherwise measurable effects to fisheries resources in Whitetail Creek, and these effects are representative of a moderate risk of low impacts to flow regime.

The erosion of forest-road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates a 78-percent reduction in sediment delivery to Whitetail Creek is expected if Action Alternative D is selected. New road construction would occur near water resources (approximately 3,600 total feet of new road within 300 feet of 4 intermittent streams) and is expected to present an overall low risk of low impacts to sediment in Whitetail Creek; a low risk is expected due the extent of vegetated buffers adjacent to the proposed new roads and potential sediment delivery distances to Whitetail Creek. The replacement of road-stream-crossing structures at 'Fish Passage Sites 128 and 129' and the Whitetail Creek bridge will cause short-term delivery at both sites (high risk of moderate short-term impacts); however, long-term risks of impacts to sediment at both sites are expected to be low.

Increased truck traffic can also accelerate the mobilization and erosion of roadbed material at road-stream crossings (*Reid and Dunne 1984, Bilby et al 1989, Coker et al 1993, Luce and Black 2001*). The foreseeable total number of passes by project-related vehicles at all perennial road-stream crossing sites is approximately 8,816. (For analysis details, see *SECTION 8* of the document titled *WHITETAIL PORCUPINE EIS, FISHERIES ANALYSIS: SUPPLEMENTAL ANALYSIS DETAILS, 15 MAY 2008* in the project file.) However, through the implementation of project-specific BMPs and road maintenance, the applicable road-stream crossing sites would be expected to deliver most mobilized sediment away from the stream and road prism and filter eroded material through roadside vegetation. These actions are expected to substantially offset the risk of increased sedimentation due to the anticipated levels of project-specific vehicle traffic.

A 100-foot equipment-exclusion zone would be implemented along tributaries to Whitetail Creek adjacent to proposed harvest unit '242317', which is expected to greatly reduce potential sediment delivery from ground disturbances related to upland harvesting (*Davies and Nelson 1994, Castelle and Johnson 2000, Parker 2005, Rashin et al 2006*). Application of the SMZ Law is expected to reduce potential sediment delivery from ground disturbances adjacent to perennial and intermittent, non-fish-bearing streams in the analysis area.

Considerations for impacts to sediment include a positive impact due to the implementation of project-specific BMPs and road maintenance, a risk of fine sediment delivery to Whitetail Creek from increased project-specific traffic and new road construction, and a high risk of moderate short-term impacts from 3 road-stream-crossing structure replacements. A net high risk of moderate impacts is expected in the short term, and a low risk of low impacts to affected fish species and affected fisheries resources is expected in the long term.

Potential impacts to channel forms are expected to be primarily a function of (long term) changes in flow regime and sediment. As a result, a proportional, or low, impact is expected to all channel-form variables.

A 100-foot-wide, no-harvest zone would be implemented along tributaries to Whitetail Creek adjacent to proposed harvest unit '242317'. As a result of the proposed action, riparian stand characteristics and habitat types are not expected to be affected. Due to hydrologic and soil features associated with the riparian habitat type, the rate of riparian tree blowdown may increase (*Hansen et al 1995*, *Sirucek and Bachurski 1995*). Scientific literature reviews (*Belt et al 1992, McGreer 1994, Castelle and Johnson 2000*) suggest a no-harvest zone of this extent is expected to greatly reduce potential upland harvesting effects to in-stream shading.

Considering riparian stand characteristics and the implementation of a 100-foot-wide, no-harvest zone, potential impacts to large woody debris in Whitetail Creek are expected to be greatly reduced; this assessment is based on similar observations from other related studies (*Murphy and Koski 1989*, *McDade et al 1990*, *Robinson and Beschta 1990*, *Van Sickle and Gregory 1990*).

The mean weekly maximum stream temperature may increase slightly due to potential effects to flow regime and sediment. Implementation of a 100-foot wide, no-harvest zone along tributaries to Whitetail Creek is expected to greatly reduce potential effects to stream temperature as a result of potential changes to the riparian condition (*Beschta et al 1987*, *Brosofske et al 1997*, *Wilkerson et al 2006*). Application of the SMZ Law is expected to reduce potential effects to stream temperature in perennial and intermittent non-fish-bearing streams in the analysis area.

Macroinvertebrate richness may decrease slightly due to potential effects to flow regime and sediment (*Herlihy et al 2005*, *VanDusen et al 2005*). Implementation of a 100-foot-wide, no-harvest zone is expected to reduce potential positive or adverse effects to macroinvertebrate richness as a result of potential changes to riparian condition (*Newbold et al 1980*, *Carlson et al 1990*, *Moldenke and Ver Linden 2007*).

A low risk of low adverse impacts to the riparian condition, large woody debris, stream temperature, and macroinvertebrate richness is expected as a result of implementing Action Alternative D.

Effects to connectivity and populations would be the same as those described for Action Alternative B.

- ***Cumulative Effects of No-Action Alternative A on the South Woodward Creek Analysis Area***

  The other related past and present factors and site-specific existing conditions described in *EXISTING ENVIRONMENT* would continue to occur. Other future related actions include those described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 - PURPOSE AND NEED*. These related actions include moderate levels of timber harvesting and associated road use on private lands and the potential conversion of forest timberlands to residential use; these actions are expected to have a moderate risk of low impacts to fisheries resources. Considering all of these impacts collectively, a moderate risk of moderate cumulative impacts is expected to occur. Although the anticipated moderate cumulative effect is a function of all potentially related impacts, the elevated cumulative effect in the analysis area is primarily due to adverse impacts from nonnative fish species.

- ***Cumulative Effects of Action Alternative B on the Whitetail Creek Analysis Area***

  Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from Action Alternative B may cause additional low to moderate impacts to multiple fisheries resources. Consequently, a moderate to high risk of moderate cumulative impacts to fisheries resources is expected in the analysis area.

- ***Cumulative Effects of Action Alternative C on the Whitetail Creek Analysis Area***

  Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from Action Alternative C may cause additional low to moderate impacts to multiple fisheries resources. Consequently, a high risk of moderate cumulative impacts to fisheries resources is expected in the analysis area.

- ***Cumulative Effects of Action Alternative D on the Whitetail Creek Analysis Area***

  Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from Action Alternative D may cause additional low to moderate impacts to multiple fisheries resources. Consequently, a moderate to high risk of moderate cumulative impacts to fisheries resources is expected in the analysis area.

➢ WOODWARD CREEK ANALYSIS AREA

The proposed actions affecting fisheries resources in the Woodward Creek Analysis Area include:

- use of a major haul route for timber and equipment transportation,
- substantial road surface maintenance,
- new road construction,
- upland harvesting, and
  riparian harvesting.

The primary point-source mechanism through which fisheries resources are affected by the proposed actions is sediment delivery to fish habitats at 3 road crossings of perennial stream reaches (see *FIGURE F-7 – DETAIL: WOODWARD CREEK ANALYSIS AREA*). The primary nonpoint-source mechanisms through which fisheries resources are affected by the proposed actions are (1) modifications of flow regime from upland harvesting, (2) sediment delivery from riparian harvesting, and (3) effects to large woody debris and stream temperature from riparian harvesting. For analysis in this EIS, flow regime, sediment, channel forms, and macroinvertebrate richness are the measurable or detectable fisheries resources expected to be potentially affected by the proposed actions.

The resources of riparian conditions, large woody debris, and stream temperature will not be carried through additional analysis since (1) potential riparian harvesting would occur on non-fish-bearing intermittent reaches approximately 1 mile upstream of fish-bearing reaches, and (2) the intermittent reaches are dry during base flows when riparian conditions and stream temperature have the most potential to have a measurable or detectable effect on fisheries resources. Although connectivity at Site 355 (see below) is impaired, no proposed actions would affect this variable; therefore, an effects assessment is not needed for this particular resource.

EXISTING ENVIRONMENT – WOODWARD CREEK ANALYSIS AREA

Affected fish species in the Woodward Creek Analysis Area include bull trout, westslope cutthroat trout, mountain whitefish, eastern brook trout, and rainbow trout (*MFISH 2007*). Fish presence/absence surveys by a DNRC fish biologist during 2007 identified a fish-bearing tributary to Woodward Creek that intersects the major haul route at 'Fish Passage Site 355' (see *FIGURE F-7 – DETAIL: WOODWARD CREEK ANALYSIS AREA*). Eastern brook trout are the only fish species found in the tributary at this time, but this entire stream very likely contained westslope cutthroat trout and to a limited extent, bull trout and sculpin during presettlement. For the purposes of this environmental assessment this tributary will be considered westslope cutthroat trout habitat.

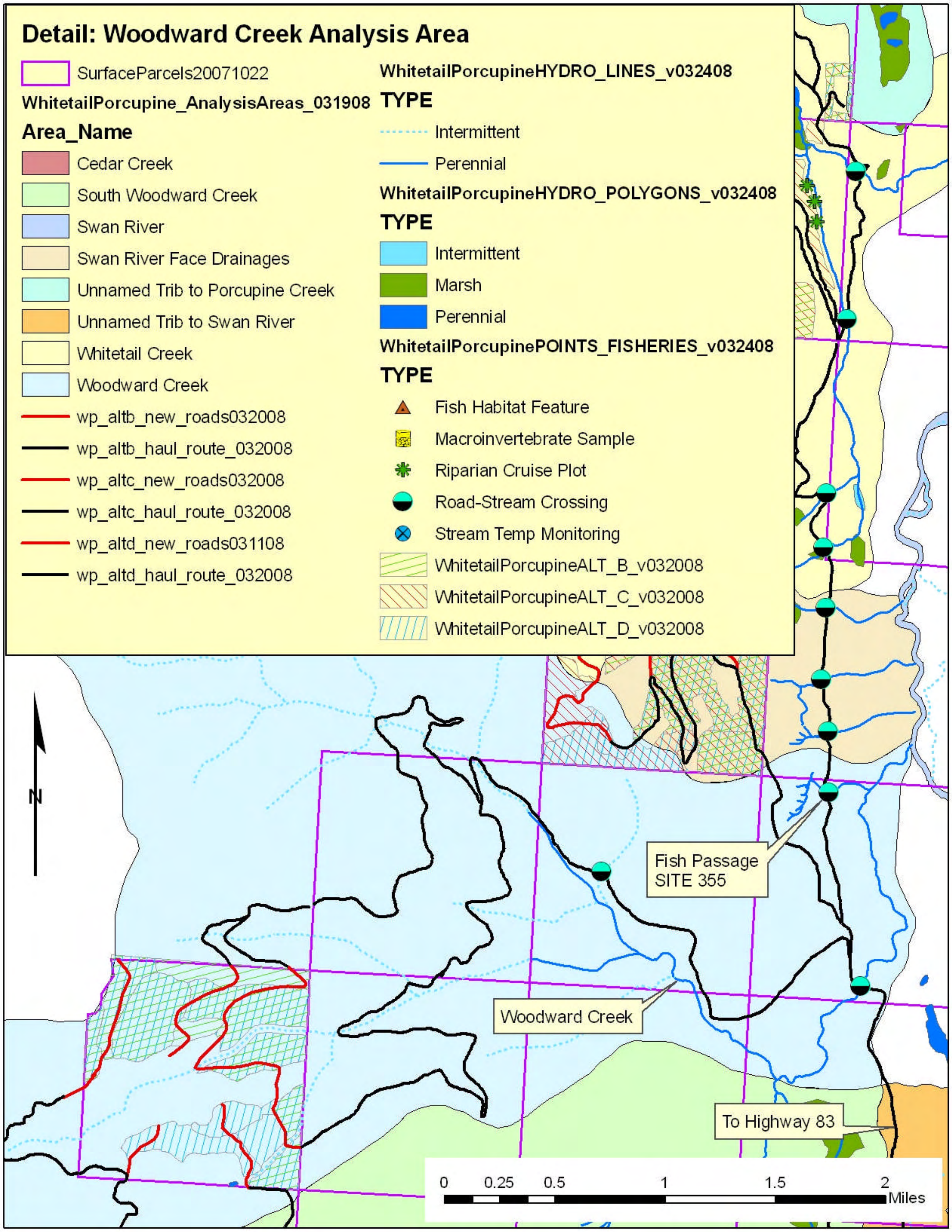
The analysis of hydrologic data for Woodward Creek indicates that the existing average departure in water yield is approximately 7.2 percent above the range of naturally occurring conditions (see *HYDROLOGY ANALYSIS*), which is primarily a result of past forest-crown removal from timber harvesting. The variables of existing peak seasonal flow volume, flow time, and flow duration are expected to be within the range of natural variability.

Downstream reaches of Woodward Creek exhibit:

- an average percent fine sediment (*McNeil core*) of 36.3 percent (range of 34.2 to 38.1 percent, 1996 through 2006) (*T. Weaver, DFWP Kalispell*),
- an average substrate score (embeddedness) of 10.2 (range of 9.3 to 10.9, 1996 through 2007 [*T. Weaver, DFWP Kalispell*]), and
- surface substrate fine sediment (0 to 8 millimeters) ranging from 13 to 33 percent (*Koopal 2001*).

Although the average percent fine sediment of 36.3 percent and substrate score of 10.2, and the associated ranges of

FIGURE F-7 – DETAIL: WOODWARD CREEK ANALYSIS AREA



values, may indicate a condition that is marginally acceptable to threatening for native-species embryo survival (*FBC 1991*), the conditions are not necessarily unexpected due to the stable, spring-fed-dominated flow regime of the stream. However, the long-term dataset of substrate score (1996 through 2006) indicates a statistically significant ($P<0.05$) trend in increasing embeddedness, which is considered a moderate existing impact. Woodward Creek exhibits B4 and C4 channel morphologies, and measures of surface substrate fine sediment are within the expected averages of 33 percent and 27 percent, respectively, for those channel types (*Rosgen 1996*).

The existing structures at the 3 road-stream crossings include 1 bridge and 2 culverts, all of which are at a low risk of failure during high-flow events. A quantitative field survey for the *HYDROLOGY ANALYSIS* indicates approximately 3.5 tons per year of fine sediment is delivered to the Woodward Creek Analysis Area from all road-stream crossing sites. Based on this information, a low impact to sediment is likely occurring in Woodward Creek, but the existing condition is also likely to be within the expected range of variability found in the stream reach.

'Slow' habitat features (*Overton et al 1997*) comprise approximately 7 percent of the stream area and 13 percent of the stream volume in C channel-type reaches, and approximately 3 percent of the stream area and 4 percent of the stream volume in B channel type reaches (*Koopal 2001*). The measures of channel-form habitat for the B channel-type reaches are substantially lower than other observations in Swan River State Forest, and may be due to well-below-average large woody debris frequency in the stream (*Koopal 2001, Bower 2006*) from past elevated levels of riparian harvesting. Large woody debris is an important component of channel-form development, sediment storage, and habitat complexity (*Bilby and Bisson 1998*, *Hauer et al 1999*). Due to this effect mechanism, the existence of a moderate impact to channel forms is a reasonable presumption. Over 99 percent of channel banks were observed to be stable (*Overton et al 1997*). Descriptions of channel type using *Montgomery and Buffington (1997*) are not available.

A quantitative analysis of macroinvertebrate samples and index derivation is not available for Woodward Creek; however, the measured increases in embeddedness may indicate a low risk of low impacts to macroinvertebrate richness (*Herlihy et al 2005*, *VanDusen et al 2005*).

Based on the above assessment of existing conditions, low existing impacts to flow regime, sediment, and macroinvertebrate richness appear to occur. A moderate existing impact to channel forms appears to occur. Other past and present factors affecting the Woodward Creek Analysis Area include those actions described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 – PURPOSE AND NEED*. These factors include adverse impacts from nonnative fish species, moderate levels of riparian harvesting, moderate levels of upland harvesting, timber and equipment hauling by other landowners, and other publicly open road-stream crossing sites. These other factors, in conjunction with those site-specific existing conditions assessed above, contribute an existing moderate collective impact to the Woodward Creek Analysis Area.

ENVIRONMENTAL EFFECTS – WOODWARD CREEK ANALYSIS AREA

- ***Direct and Indirect Effects of No-Action Alternative A on the Woodward Creek Analysis Area***

  No direct or indirect impacts would occur to affected fish species or other affected fisheries resources beyond those described in *EXISTING ENVIRONMENT*.

- ***Direct and Indirect Effects of Action Alternative B on the Woodward Creek Analysis Area***

  The *HYDROLOGY ANALYSIS* indicates the proposed actions related to Action Alternative B are expected to result in a cumulative increase in water yield of 9.2 percent in Woodward Creek. The expected increase in water yield is 2.0 percent above the existing condition. Peak seasonal flow volumes may be slightly greater, peak seasonal flow time may be slightly earlier, and peak seasonal flow duration may be slightly longer. However, these expected minor departures in flow regime are not likely to have detectable or otherwise measurable effects to fisheries resources in Woodward Creek, and these effects are representative of a moderate risk of very low impacts to the flow regime.

  The erosion of forest-road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates a 40-percent reduction in sediment delivery to Woodward Creek is expected if Action Alternative B is selected. New road construction would occur near water resources (approximately 1,000 feet total within 300 feet of 2 intermittent streams) and is expected to present an overall low risk of low impacts to sediment in Woodward Creek; a low risk is expected due the extent of vegetated buffers adjacent to the proposed new roads and potential sediment delivery distances to Woodward Creek.

  Increased truck traffic can also accelerate the mobilization and erosion of roadbed material at road-stream crossings (*Reid and Dunne 1984, Bilby et al 1989, Coker et al 1993, Luce and Black 2001*). The foreseeable total number of passes by project-related vehicles at all perennial road-stream crossing sites is approximately 12,947. (For analysis details see *SECTION 3* of the document titled *WHITETAIL PORCUPINE EIS, FISHERIES ANALYSIS: SUPPLEMENTAL ANALYSIS DETAILS, 15 MAY 2008* in the project file.) However, through the implementation of project-specific BMPs and road maintenance, the applicable road-stream crossing sites would be expected to deliver most mobilized sediment away from the stream and road prism and filter eroded material through roadside vegetation. These actions are expected to substantially offset the risk of increased sedimentation due to the anticipated levels of project-specific vehicle traffic.

A 50- to 100-foot equipment-exclusion zone would be implemented along 2 intermittent tributaries to Woodward Creek (see *FIGURE F-7 – DETAIL: WOODWARD CREEK ANALYSIS AREA*), which is expected to reduce potential sediment delivery from ground disturbances related to upland harvesting (*Davies and Nelson 1994*, *Castelle and Johnson 2000*, *Parker 2005*, *Rashin et al 2006*). Application of the SMZ Law is expected to reduce potential sediment delivery from ground disturbances adjacent to perennial and intermittent, non-fish-bearing streams in the analysis area.

Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to Woodward Creek from increased project-specific traffic, new road construction, and upland harvesting, a net low risk of low impacts to affected fish species and affected fisheries resources (sediment) is expected.

Potential impacts to channel forms are expected to be primarily a function of changes in flow regime and sediment. As a result, a proportional, or low, impact is expected to all channel-form variables.

No measurable or detectable effects to macroinvertebrate richness in fish-bearing reaches are expected from riparian harvesting along 2 intermittent tributaries to Woodward Creek. Macroinvertebrate richness may decrease slightly due to potential effects to flow regime and sediment (*Herlihy et al 2005*, *VanDusen et al 2005*).

- ***Direct and Indirect Effects of Action Alternative C on the Woodward Creek Analysis Area***

The *HYDROLOGY ANALYSIS* indicates the proposed actions related to Action Alternative C are expected to result in a cumulative increase in water yield of 7.8 percent in Woodward Creek. The expected increase in water yield is 0.6 percent above the existing condition. Peak seasonal flow volumes may be slightly greater, peak seasonal flow time may be slightly earlier, and peak seasonal flow duration may be slightly longer. However, these expected minor departures in flow regime are not likely to have detectable or otherwise measurable effects to fisheries resources in Woodward Creek, and these effects are representative of a moderate risk of very low impacts to flow regime.

The erosion of forest-road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates a 46-percent reduction in sediment delivery to Woodward Creek is expected if Action Alternative C is selected. New road construction would not occur near water resources and is expected to present an overall low risk of very low impacts to sediment in Woodward Creek.

Increased truck traffic can also accelerate the mobilization and erosion of roadbed material at road-stream crossings (*Reid and Dunne 1984, Bilby et al 1989, Coker et al 1993, Luce and Black 2001*). The foreseeable total number of passes by project-related vehicles at all perennial road-stream crossing sites is approximately 17,422. (For analysis details see *SECTION 4* of the document titled *WHITETAIL PORCUPINE EIS, FISHERIES ANALYSIS: SUPPLEMENTAL ANALYSIS DETAILS, 15 MAY 2008* in project file.) However, through the implementation of project-specific BMPs and road maintenance, the applicable road-stream crossing sites would be expected to deliver most mobilized sediment away from the stream and road prism and filter eroded material through roadside vegetation. These actions are expected to substantially offset the risk of increased sedimentation due to the anticipated levels of project-specific vehicle traffic.

Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to Woodward Creek from increased project-specific traffic, a net low risk of low impacts to affected fish species and affected fisheries resources (sediment) is expected.

Potential impacts to channel forms are expected to be primarily a function of changes in flow regime and sediment. As a result, a proportional, or low, impact is expected to all channel-form variables.

Macroinvertebrate richness may decrease slightly due to potential effects to flow regime and sediment (*Herlihy et al 2005*, *VanDusen et al 2005*).

- ***Direct and Indirect Effects of Action Alternative D on the Woodward Creek Analysis Area***

The *HYDROLOGY ANALYSIS* indicates the proposed actions related to Action Alternative D are expected to result in a cumulative increase in water yield of 9.7 percent in Woodward Creek. The expected increase in water yield is 2.5 percent above the existing condition. Peak seasonal flow volumes may be slightly greater, peak seasonal flow time may be slightly earlier, and peak seasonal flow duration may be slightly longer. However, these expected minor departures in flow regime are not likely to have detectable or otherwise measurable effects to fisheries resources in Woodward Creek, and these effects are representative of a moderate risk of very low impacts to flow regime.

The erosion of forest-road surfaces and the potential delivery of fine material to stream channels are a function of the application of forestry BMPs, including road design, road traffic, road surface composition, and road maintenance. Through the implementation of project-specific BMPs and road maintenance, the *HYDROLOGY ANALYSIS* indicates a 46 percent reduction in sediment delivery to Woodward Creek is expected if Action Alternative D is selected. New road construction would occur near water resources (approximately 1,200 feet total within 300 feet of 2 intermittent streams) and is expected to present an overall low risk of low impacts to sediment in Woodward Creek; a low risk is expected due the extent of vegetated buffers adjacent to the proposed new roads and potential sediment-delivery distances to Woodward Creek.

Increased truck traffic can also accelerate the mobilization and erosion of roadbed material at road-stream crossings (*Reid and Dunne 1984, Bilby et al 1989, Coker et al 1993, Luce and Black 2001*). The foreseeable total number of passes by project-related vehicles at all perennial road-stream crossing sites is approximately 9,825. (For analysis details see *SECTION 5* of document titled *WHITETAIL PORCUPINE EIS, FISHERIES ANALYSIS: SUPPLEMENTAL ANALYSIS DETAILS, 15 MAY 2008* in the project file.) However, through the implementation of project-specific BMPs and road maintenance, the applicable road-stream crossing sites would be expected to deliver most mobilized sediment away from the stream and road prism and filter eroded material through roadside vegetation. These actions are expected to substantially offset the risk of increased sedimentation due to the anticipated levels of project-specific vehicle traffic.

A 50- to 100-foot equipment exclusion zone would be implemented along 2 intermittent tributaries to Woodward Creek (see *FIGURE F-7 – DETAIL: SOUTH WOODWARD CREEK ANALYSIS AREA*), which is expected to reduce potential sediment delivery from ground disturbances related to upland harvesting (*Davies and Nelson 1994, Castelle and Johnson 2000, Parker 2005, Rashin et al 2006*). Application of the SMZ Law is expected to reduce potential sediment delivery from ground disturbances adjacent to perennial and intermittent non-fish-bearing streams in the analysis area.

Considering a positive impact due to the implementation of project-specific BMPs and road maintenance, but a risk of fine sediment delivery to Woodward Creek from increased project-specific traffic, new road construction, and upland harvesting, a net low risk of low impacts to affected fish species and affected fisheries resources (sediment) is expected.

Potential impacts to channel forms are expected to be primarily a function of changes in flow regime and sediment. As a result, a proportional, or low, impact is expected to all channel form variables.

No measurable or detectable effects to macroinvertebrate richness in fish-bearing reaches are expected from riparian harvesting along 2 intermittent tributaries to Woodward Creek. Macroinvertebrate richness may decrease slightly due to potential effects to flow regime and sediment (*Herlihy et al 2005, VanDusen et al 2005*).

- ***Cumulative Effects of No-Action Alternative A on the Woodward Creek Analysis Area***

The other related past and present factors and site-specific existing conditions described in *EXISTING*

ENVIRONMENT would continue to occur. Other future related actions include those described under *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS* in *CHAPTER 1 - PURPOSE AND NEED.* These related actions include moderate levels of timber harvesting and associated road use on private lands and the potential conversion of forest timberlands to residential use; these actions are expected to have a moderate risk of low impacts to fisheries resources. Considering all of these impacts collectively a moderate risk of moderate cumulative impacts is expected to occur. Although the anticipated moderate cumulative effect is a function of all potentially related impacts, the elevated cumulative effect in the analysis area is primarily due to adverse impacts from nonnative fish species.

- ***Cumulative Effects of Action Alternatives B, C, and D on the Woodward Creek Analysis Area***

  Using the expected cumulative effects described for No-Action Alternative A as a baseline, the level of anticipated direct and indirect effects from these action alternatives may cause additional low to moderate impacts to multiple fisheries resources. Consequently, a moderate risk of moderate cumulative impacts to fisheries resources is expected in the analysis area.

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INTRODUCTION

This analysis is designed to disclose the existing condition of affected or potentially affected wildlife resources and display the anticipated effects that may result from each alternative of this proposed action. The following sections disclose the anticipated direct, indirect, and cumulative effects to these wildlife resources from the proposed action in the project area and cumulative-effects analysis areas described for each resource category. Past and current activities on all ownerships within each analysis area, as well as planned future agency actions, have been taken into account in each cumulative-effects analysis.

ISSUES AND MEASUREMENT CRITERIA

Numerous issues regarding wildlife species and their habitat were identified through public and internal scoping. These issues are listed in *TABLE I–1 – ISSUES STUDIED IN DETAIL* (*CHAPTER I*) and are reiterated at the beginning of the following sections. Different measurement criteria were used to evaluate the effects of the alternatives on wildlife resources, depending on the resource or habitat need specified. The criteria used for evaluation are described under *ANALYSIS AREA* and *ANALYSIS METHODS* under each issue.

ANALYSIS AREAS

The discussions of existing conditions and environmental effects will focus on 2 different scales. The first will be the "Project Area" (see *PROJECT AREA MAP* located before *CHAPTER I).* The project area lies on the west side of Swan River State Forest. Elevations range from 3,160 to 6,160 feet, and the area includes parts of 4 major tributaries to Swan River: Porcupine, Whitetail, Woodward, and South Woodward creeks.

The second scale or the "cumulative-effects analysis area" relates to the surrounding landscape for assessing cumulative effects to wildlife and their habitats. The 2 cumulative-effects analysis areas most commonly used throughout the wildlife analysis include Swan River State Forest and the Porcupine-Woodward Grizzly Bear Subunit. The Swan River State Forest cumulative-effects analysis area includes lands within the perimeter of Swan River State Forest. Existing conditions and effects of alternatives are discussed quantitatively in terms of the conditions and effects to the various resources on DNRC-managed lands in Swan River State Forest. While DNRC does not have adequate data to quantitatively discuss conditions on other land ownerships in the analysis area (primarily Plum Creek and USFS), we acknowledge that management actions on these other lands can have ecological effects to resources on DNRC-managed lands; thus, these effects will be discussed qualitatively.

The Porcupine-Woodward Grizzly Bear Subunit is also used as a cumulative-effects analysis area throughout the wildlife analysis. This 37,614-acre area encompasses 4 main drainages (Porcupine, Whitetail, Woodward, and South Woodward creeks) and covers a large enough area to approximate the size of a home range for a female grizzly bear. Land ownership within the subunit includes State, Plum Creek, USFS, and other small owners (*TABLE W-1 – PORCUPINE WOODWARD OWNERSHIP*).

TABLE W-1 - PORCUPINE WOODWARD OWNERSHIP. Acreages and percents of lands by ownership in the Porcupine Woodward Grizzly Bear Subunit.

	ACRES	PERCENT
USFS	15,431	41.0
State	12,249	32.6
Plum Creek	8,586	22.8
Other Agency/Private	1,348	3.6
Totals	37,614	100

ANALYSIS METHODS

DNRC attempts to promote biodiversity by taking a 'coarse-filter approach', which favors an appropriate mix of stand structures and compositions on State lands (*ARM 36.11.404*). Appropriate stand structures are based on ecological characteristics (e.g., landtype, habitat type, disturbance regime, unique characteristics). A coarse-filter approach assumes that if landscape patterns and processes are maintained similar to those with which the species evolved, the full complement of species would persist and biodiversity would be maintained. This coarse-filter approach supports diverse wildlife populations by managing for a variety of forest structures and compositions that approximate historic conditions across the landscape. DNRC cannot assure that the coarse-filter approach will adequately address the full range of biodiversity; therefore, DNRC also employs a 'fine-filter' approach for threatened, endangered, and sensitive species (*ARM 36.11.406*). The fine-filter approach focuses on a single species' habitat requirements.

For each species or habitat issue, existing conditions of wildlife habitats are described and compared to the anticipated effects of the proposed no-action alternative and each action alternative to determine the foreseeable effects to associated wildlife habitats.

To assess the existing condition of the proposed project area and surrounding landscape, a variety of techniques were used. Field visits, scientific literature, SLI data, aerial photographs, MNHP data, and consultations with other professionals provided information for the following discussion and effects analysis. Specialized methodologies are discussed under the species in which they occur. Species were dismissed from further analysis if habitat did not exist in the project area or would not be modified by any alternative.

RELEVANT AGREEMENTS, LAWS, PLANS, RULES, AND REGULATIONS

Various legal documents dictate criteria for management of terrestrial wildlife and their habitats on state lands. The documents most pertinent to this project include DNRC Forest Management Rules, the SVGBCA, the Endangered Species Act, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act.

COARSE-FILTER WILDLIFE ANALYSIS

COVERTYPE

Issue*:* The proposed activities could result in changes in the distribution of different covertypes on the landscape, which could affect wildlife.

Introduction

Different covertypes can provide a variety of habitats for wildlife species. While some species seem unaffected by covertype, others can be found more abundantly in some covertypes versus others. This preference for certain covertypes may reflect a direct relationship between the wildlife species and the vegetation (e.g. the animal may prefer to browse on a certain tree species), but more often the relationship results from the preference for particular characteristics associated with the covertype. For example, drier covertypes, such as ponderosa pine, are typically associated with a more open, grassy understory that may provide forage for browsers or open hunting areas for species such as the flammulated owl (*Otus flammeolus*; *McCallum 1994*). In contrast, subalpine fir and spruce forests typically support a dense understory structure that is favored by snowshoe hares (*Lepus americanus*) and lynx (*Lynx canadensis*; *Hodges 2000, Ruediger et al. 2000*). In an attempt to provide an appropriate diversity of covertypes to support a host of different wildlife species, DNRC attempts to manage for a diversity of covertypes in proportions similar to what were historically present on Swan River State Forest.

Analysis Area and Methods

For this analysis, the percentage of the project area in each major covertype was assessed using SLI data (see *COVERTYPE* and *AGE CLASSES* in *VEGETATION ANALYSIS*). To assess the direct and indirect effects of the proposed activities, the change in covertype acres by alternative was evaluated. Cumulative effects to covertypes were assessed in the Swan River State Forest cumulative-effects analysis area. Measurement criteria included the changes in acres of covertype.

Existing Environment

The project area covertype distributions are skewed away from historic proportions. Mixed-conifer covertypes are overrepresented, while western larch/ Douglas-fir and western white pine types are vastly underrepresented compared with the historical proportions of these covertypes (*Losensky 1997*). The same pattern is seen on DNRC-managed lands in the cumulative-effects analysis area (see *COVERTYPE* and *AGE CLASSES* in *VEGETATION ANALYSIS*). These conditions likely lead to increased habitat availability for species that use dense stands that include a variety of tree species, while providing fewer habitats for those species that use the more-open stands dominated by shade-intolerant tree species.

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Covertypes***

  In the short term, no effects to covertypes would be expected. Over the next several decades, however, shade-intolerant trees would continue to die and be replaced by shade-tolerant species. These conditions would lead to an increasing deviation from historic distributions of covertypes and, thus, reduce the amount of habitat for species associated with shade-intolerant covertypes. For example, shade-intolerant western larch are preferred trees for nesting pileated woodpeckers in Swan Valley (*McClelland and McClelland 1999*). Species that are associated with shade-tolerant habitat types could benefit from an increased amount of habitat. Therefore, the effects of this alternative could be negative for wildlife species associated with shade-intolerant covertypes and the goal of maintaining a diversity of species.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Covertypes***

  Action Alternatives B, C, and D would involve covertype conversions on 337, 376, and 245 acres in the project area, respectively. The majority of these stands are currently mixed conifer and would be converted to western larch/Douglas-fir or western white pine covertypes, which would help ensure their presence on the landscape. The result would bring the proportions of shade-intolerant covertypes slightly closer to historic conditions and, thus, provide more habitat for species associated with the shade-intolerant covertypes once the stands regenerate. Thus, the effects of this alternative would be positive for wildlife species associated with shade-intolerant covertypes and for the goal of maintaining a diversity of species, but negative effects could be felt by species associated with shade-tolerant habitat types.

- ***Cumulative Effects of No-Action Alternative A to Covertypes***

Mixed-conifer covertypes would remain disproportionately high on DNRC-managed lands on Swan River State Forest, resulting in less habitat for wildlife species associated with the shade-intolerant covertypes. No other management actions are planned that would influence wildlife habitat via covertype changes, as other projects currently planned for Swan River State Forest include only salvages, sanitation harvests, and precommercial thinnings (see *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER I*), all of which would not change the current covertype. White pine blister rust and dwarf mistletoe would continue affecting the western white pine and western larch trees within the area, further decreasing the amounts of these covertypes in the cumulative-effects analysis area. Over time, the proportion of shade-tolerant covertypes would continue to increase on DNRC-managed lands on Swan River State Forest, further decreasing habitat for wildlife species that use shade-intolerant types or a variety of habitat types.

- ***Cumulative Effects of Action Alternatives B, C, and D to Covertypes***

The cumulative effects of recent forest-management activities on Swan River State Forest result in a trend of increasing seral covertypes across areas where management has occurred. Actions associated with any of the action alternatives would be additive to past actions on Swan River State Forest and any management actions on other lands within the cumulative-effects analysis area. Ongoing and future projects planned by DNRC (see *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER J*) would not affect covertype proportions. DNRC is unaware of any plans by USFS to manage timber within the cumulative-effects analysis area and, thus, would expect to see no change in the proportions of covertypes, which are likely skewed towards the shade-tolerant species. Future timber harvesting on Plum Creek lands within the cumulative-effects analysis area could promote shade-intolerant species. Efforts by DNRC to plant rust-resistant western white pine could help to counteract the effects of blister rust that is decreasing the abundance of this covertype. In general, wildlife species that evolved under historic disturbance regimes would benefit from the additional changes in covertype distributions. However, these benefits would only be realized in the longer term due to the necessary conversion of older-aged stands to younger-aged stands in order to successfully make the species covertype conversions. Thus, the cumulative effects would tend towards the positive for species that use shade-intolerant covertypes at the possible expense of those that use shade-intolerant types.

AGE CLASS

Issue: The proposed activities could alter the representation of stand age classes on the landscape, which could affect wildlife.

Introduction

Different ages of forest stands can provide a variety of habitats for wildlife species. Some species of terrestrial animals such as the ruffed grouse (*Bonasa umbellus*) are typically associated with early successional forests (*Dessecker and McAuley 2001*), while some species such as the pine marten (*Martes pennanti*) are associated with mature stands (*Buskirk and Ruggiero 1994*). Other species, such as the snowshoe hare, can be found in younger stands of regenerating trees, as well as mature forest stands, but are not typically found in midsuccessional stands (*Hodges 2000*). In an attempt to provide an appropriate diversity of forest stands to support a host of different wildlife species, DNRC considers historic proportions and distributions of age classes.

Analysis Area and Methods

Stands on Swan River State Forest were categorized as 0 to 39 years, 40 to 99 years, 100 years to old, and old stands (*COVERTYPE* and *AGE CLASSES* in *VEGETATION ANALYSIS*). The change in acres of each age class by alternative was used to assess the potential effects to wildlife. Changes to the project area by alternative are considered in *DIRECT AND INDIRECT EFFECTS* below; cumulative effects were analyzed at the scale of the contiguous Swan River State Forest to provide consistency with the discussion in *VEGETATION ANALYSIS*.

Existing Environment

In the project area, stands in the 100-year-old or older age classes comprise nearly two-thirds of the forest, whereas the 0-to-39-year-old stands and 40-to-99-year-old stands each comprise roughly 20 percent. Compared to the reported historic data for the climatic section, young stands are underrepresented, while older stands are overrepresented (*COVERTYPE* and *AGE CLASSES* in *VEGETATION ANALYSIS*). On DNRC-managed lands across the Swan River State Forest cumulative-effects analysis area, similar trends exist in which 100-years-plus stands are the most abundant, while young stands are least abundant. Older stands are also most abundant on USFS lands, while the majority of Plum Creek lands exist in younger (less than 50 years old) stands. The abundance of older stands likely reflects a lack of disturbance over the last century or more, which is consistent with the history of fire suppression in the area. These conditions result in relatively low habitat availability for species that use younger-aged stands, while providing abundant habitat for those species that use mature forested stands at the scales of both the project area and Swan River State Forest.

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Age Class***

  In the short term, no effects to age class would be expected. Over time, the proportions of older to younger stands would become higher. These conditions would lead to an increasing deviation from historic distributions of age classes and, thus, increase the risk of not providing adequate levels of habitat for species associated with younger age-class forest conditions.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Age Class***

  Action Alternatives B, C, and D would involve regeneration harvests that would convert older age stands to the youngest age class across 1,234 acres, 1,403 acres, or 1,051 acres, respectively. Under any of the alternatives, older stands (100-years-plus) would still comprise approximately half of the project area. Short-term effects to wildlife that use mature forest stands would be a reduction in habitat, while wildlife species that use meadows and early successional forests would benefit from an increase in habitat availability.

- ***Cumulative Effects of No-Action Alternative A to Age Class***

  Projects on Swan River State Forest, including the Three Creeks Timber Sales and other large timber sales in the recent past ((see *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER I*), reflect a trend towards increasing the proportion of acres in the 0-to-39-year age class while decreasing the proportion of older age classes on the forest. The smaller timber permits that have recently been conducted or are being developed would not change age classes of the stands they affect. Because no changes to age class would result under this alternative, no cumulative effects to age-class distributions in the analysis area would be expected, resulting in slight negative effects to wildlife species associated with younger age classes and slight positive effects to wildlife associated with older age classes.

- ***Cumulative Effects of Action Alternatives B, C, and D to Age Class***

  The cumulative effects of recent forest-management activities on Swan River State Forest result in a trend of increasing amounts of younger age classes across areas where management has recently occurred. These trends generally tend towards historic proportions of age classes across the analysis area (see *COVERTYPE AND AGE CLASSES* in *VEGETATION ANALYSIS*). The effects of any of the action alternatives would be to further increase the proportion of younger age classes, while decreasing the proportion of the older age stands. These effects would be additive to actions by other landowners in the cumulative-effects analysis area that have, or could in the future, change the proportions of age classes in the area. DNRC is unaware of any future plans by USFS to change age classes on their ownership in the cumulative-effects analysis area. Past and potential future timber sales by Plum Creek and small, private landowners have increased, and could continue to increase, the acreage of stands in the younger age classes, providing more habitat for wildlife species associated with younger stands on these areas. Therefore, the cumulative effects to wildlife species would be slightly negative to species associated with older forest stands, but positive for species that use younger age classes. In time, as historic proportions of age classes were restored, habitat proportions would more closely reflect the proportions under which wildlife in western Montana evolved, resulting in potential benefits to biodiversity.

OLD GROWTH

Issue: The proposed activities could affect wildlife species associated with old-growth forests by reducing the acreage of available habitat.

Introduction

Old-growth forests are an important component of biological diversity, as the increased vertical and horizontal structures in these stands provide for a diverse assemblage of wildlife species. Although the individual species occurring in old-growth stands may not be unique to old growth, the diversity of species and the complexity of interactions between them may be different than in earlier successional stages (*Warren 1990*). FNF, which is in close proximity to Swan River State Forest and shares similar habitat attributes, has approximately 31 wildlife species associated with old-growth forests (*Warren 1998*).

When considering the effects of forest management on species associated with old-growth forests, to evaluate not only the total amount of old-growth habitats is important, but also the size and spatial juxtaposition of these habitats. Smaller patches may be unsuitable for wildlife species with large home ranges. Additionally, small, less-mobile species may be at greater risk of local extinction in small patches/habitat islands. Of 48 old-growth-associated species occurring in the Northern Rockies, about 60 percent are thought to require stands larger than 80 acres (*Harger 1978*).

Analysis Area and Methods

Old-growth forest patches were identified as described in *OLD-GROWTH* in *VEGETATION ANALYSIS.* Patch sizes and shapes were assessed using ArcGIS. Changes in the total acres of old growth, as well as the number of patches greater than 80 acres, were assessed within the project area. To provide consistency with the *VEGETATION ANALYSIS*, cumulative effects to old-growth-associated wildlife species were assessed across Swan River State Forest. Effects to wildlife were assessed in terms of the total amount of old-growth habitat and the abundance of large patches (greater than 80 acres) of old growth available.

Existing Environment

The amount of old growth on Swan River State Forest is currently less than the amount estimated in the 1930s inventory, but greater than would be expected as a long-term average for the climatic section (*Losensky 1997*; also see *OLD GROWTH* in *VEGETATION ANALYSIS*). Currently, in the project area is 2,722 acres of old growth, representing 44 percent of the project area. Although the total acres of old growth may be greater than what would have been expected with long-term average conditions, the function of old-growth stands may have been compromised for some wildlife species. Reductions of old growth in some covertypes, reductions in average patch size, irregular patch shapes, and loss of connectivity between stands of old growth have occurred due to past management and have been exacerbated in areas where ownership is mixed. Old-growth stands in the project area range from 6 to 866 acres. Six of the 22 patches are larger than 80 acres (*TABLE W-2 - OLD GROWTH*). Additionally, many of the old-growth patches in the project area share some, if not all, of their boundaries with mature, dense forests. In these cases, the effective patch size for old-growth-associated species may be larger than for patches surrounded by younger-aged forest stands. Wildlife species associated with old-growth habitats likely benefit from scenarios in which the matrix surrounding a patch of old growth consists of mature forest, versus conditions in which the matrix surrounding old-growth patches consists of a young, regenerating forest.

Presently, overabundances of old growth occur in the Douglas-fir, western white pine, mixed-conifer (includes stands dominated by western red cedar), and subalpine fir covertypes, while shortages occur in ponderosa pine, western larch/Douglas-fir, and lodgepole pine covertypes. Thus, wildlife species that are typically associated with old growth in covertypes comprised of seral tree species that are underrepresented have likely suffered from loss of habitat, while those associated with old growth in the overrepresented covertypes have likely benefited from a greater abundance of habitat.

Within the cumulative-effects analysis area, the various landowners have had differing approaches to the management of old growth, which has affected the abundance and spatial distribution of old-growth stands. The amount of current and past amounts of old growth in the cumulative-effects analysis area is difficult to quantify because little is known as to potential amounts of old growth on other ownerships, and older age class approximations were not possible with aerial photograph analysis. In general, USFS has retained much of the old-growth acreages on its lands within the cumulative-effects analysis area. Meanwhile, Plum Creek has typically had a policy allowing extensive harvesting of old growth. Portions of old stands appear to have been retained primarily along creeks and other water features; however the exact amount of old stands retained on other ownership is unknown.

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Old Growth***

  No changes to the amounts, quality, or spatial arrangement of old-growth habitats would occur in the short term. Old-growth-associated wildlife species would not be affected by any further disturbance to their habitats. In the longer-term, while some stands may mature and develop characteristics that could be beneficial to old- growth-associated species, other stands may begin

TABLE W-2 - OLD GROWTH. Number of patches and patch sizes of old-growth forests in the project area and cumulative-effects analysis area (Swan River State Forest), as well as the number and size of large patches (greater than 80 acres) of old growth remaining.

		ALTERNATIVE			
		A	B	C	D
Project area	Number of old-growth patches	22	18	22	22
	Average patch size (acres)	124	99	70	96
	Number of large patches	6	6	4	7
	Average size for large patches	378	237	242	249
Swan River State Forest	Number of old-growth patches	100	96	100	100
	Average size (acres)	115	110	103	109
	Number of large patches	30	30	28	31
	Average size for large patches	320	292	295	292

to lose their old-growth characteristics as large live trees die due to high levels of insects and diseases. Thus, because old-growth amounts would not change and patch sizes of old growth would not decrease in the short term, no effects to wildlife associated with old-growth forests would be expected.

- ***Direct and Indirect Effects of Action Alternative B to Old Growth***

The 2,722 acres of old-growth habitats in the project area would be reduced by 35 percent, resulting in 1,759 acres of old-growth forest remaining (28 percent of the project area). Additionally, 183 acres of old growth would be treated in a manner that would retain its old-growth classification, but the treatment could alter some of the current attributes and, thus, affect species using those habitats. Patch sizes and connectivity of old growth would primarily be reduced in the northern part of the project area (Whitetail Creek drainage), with little effects to the old growth in the Woodward and South Woodward drainages. The remaining patches of old growth would be scattered throughout the project area, with a few large patches in the Whitetail Creek drainage, as well as some large patches in the Woodward and South Woodward drainages. Remaining old-growth patches would range in size from 7 to 379 acres in size, with 6 patches greater than 80 acres (*TABLE W-2 - OLD GROWTH*). Thus, because the total amount of old growth would be reduced by 35 percent and the number and relative size of large patches would remain the same, minor negative effects to wildlife associated with old-growth forests would be expected under Action Alternative B.

- ***Direct and Indirect Effects of Action Alternative C to Old Growth***

The existing 2,722 acres of old-growth habitats would be reduced in the project area by 41 percent. An additional 105 acres of old growth would be treated in a manner that would retain its old-growth classification, but the treatment could alter some of the current attributes and, thus, affect species using those habitats. After treatment, 1,608 acres (26 percent of the project area) of old-growth forest would remain in the project area in patches ranging in size from 6 to 379 acres, with 4 patches greater than 80 acres. The majority of the old-growth habitats in the Whitetail Creek drainage would be removed from old growth or would have some level of harvesting that could cause disturbance or habitat alterations to species using those stands. Old-growth-associated species currently living in the Whitetail drainage would lose a large portion of the current available habitat. However, the larger patches of old growth in the South Woodward and Woodward drainages would not be disturbed, nor would the older stands bordering the old-growth patches; thus, fairly large patches of older forest in the southern sections of the project area would be retained. Thus, because old-growth amounts would be reduced by 41 percent and large patches of old growth would be reduced in the project area, moderate negative effects to wildlife associated with old-growth forests would be anticipated, although the effects would be localized in the Whitetail drainage under Action Alternative C.

- ***Direct and Indirect Effects of Action Alternative D to Old Growth***

Old-growth habitats would be decreased by 610 acres (22 percent) in the project area under this alternative. A total of 2,120 acres of old-growth forest would remain in the project area after treatment (34 percent of the project area), and 7 patches at least 80 acres in size would remain on the landscape. This is one more large patch than currently exists; the additional patch would be created at the expense of overall patch size, as the harvesting activities would fragment an existing larger patch of old growth. Patch sizes and connectivity of old-growth patches would primarily be reduced in the northern part of the project area (Whitetail Creek drainage), with little effects to the old growth in the Woodward and South Woodward drainages. Thus, because old-growth habitat would be removed from 610 acres and large patches of old growth would remain abundant in the project area, minor negative effects of old-growth-associated wildlife would be expected under Action Alternative D.

- ***Cumulative Effects of No-Action Alternative A to Old Growth***

The project would not affect any old-growth forest; thus, 12,116 acres of old growth would remain on Swan River State Forest. Future planned salvage or sanitation projects on Swan River State Forest could treat patches of old growth, but these activities generally do not result in a change in status to non-old growth and, thus, substantial reductions in the amount or size of old growth patches would not be expected. Stand attributes such as stand density, snag abundance, and presence of downed logs, however, could be affected by salvage harvests (see *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER I*). Effects associated with future salvage harvests would be considered in separate environmental reviews specific to each project. On DNRC-managed lands, stands of old growth would remain in the current size and configuration where large patches of old-growth forest are relatively abundant, though many smaller fragments also exist. The lack of treatment in other older stands could allow them to mature to old-growth status as well and decrease the number of old-growth patches in time by increasing the patch size and making more contiguous swaths of old-growth forest, which could benefit species that are associated with large expanses of old-growth forests. By contrast, however, with the current levels of insects and diseases, old-growth stands could begin to shift in their abundance of various characteristics, such as losses in large live trees, desirable stand-species composition, and increases in snags and downed logs, at accelerated rates. Current amounts of old growth would not be affected, and patch sizes of old growth in the analysis area would not be affected; therefore, no cumulative effects to old-growth-associated wildlife species would be anticipated under No-Action Alternative A.

- ***Cumulative Effects to Old Growth Common to Action Alternatives B, C, and D***

The reduction of acres of old-growth stands in the seedtree and shelterwood units and the changes in old-growth attributes in the proposed variable thin units would be additive to past disturbances and reductions of old-growth habitats in the cumulative-effects analysis area. Additional harvesting of old-growth stands on neighboring ownerships, particularly Plum Creek, could further reduce the amount and distribution of old-growth habitats in the cumulative-effects analysis area. Past, present, and reasonably foreseeable actions that could affect old growth on DNRC-managed lands were considered (*COVERTYPE* and *AGE CLASSES* in *VEGETATION ANALYSIS*). Future salvage or sanitation projects on Swan River State Forest could treat patches of old growth, but substantial reductions in the amount or size of old-growth patches would not be expected. Stand attributes such as stand density, snag abundance, and presence of downed logs, however, could be affected by future salvage projects, lowering habitat quality for species that use these habitat attributes. Local reductions in old-growth habitats would be expected to reduce habitat availability for species that use the stands affected by the action alternatives. However, under any of the action alternatives, the amount of remaining old growth would represent a substantial portion of the DNRC-managed lands in the cumulative-effects analysis area (28 to 30 percent), with nearly 33 percent of the patches being large patches (greater than 80 acres) of habitat. With the current levels of insects and diseases, old-growth stands could begin to shift in their abundance of various characteristics, such as losses in large live trees, desirable stand species composition, and increases in snags and downed logs, at accelerated rates. Thus, 1) although loss of habitat in the project area would occur with the removal of old-growth habitats on 936 acres with Action Alternative B, 1,114 acres with C, or 610 acres with D, the amount of old growth postharvest would remain relatively high in the cumulative-effects analysis area, and 2) multiple large patches of old-growth habitats would be available; therefore, low levels of negative cumulative effects to wildlife species associated with old-growth habitats would be expected under all action alternatives.

CONNECTIVITY

Issue - The proposed activities could result in disturbance or alteration of forested corridors and connectivity, which could inhibit wildlife movements.

Introduction

Connectivity of forest cover between adjacent patches is important for promoting movements of species that are hesitant to cross broad, nonforested expanses. In general, the more effective corridors are those that are relatively wide, unfragmented, diverse, and associated with riparian areas (*Fischer and Fischenich 2000*). The width of the travel corridor tends to determine the efficacy of the corridor for individual species. In general, a wider corridor would be more effective and provide for more species than a narrower one. Narrower corridors provide some level of connectivity, especially for smaller species, such as small mammals. However, these narrow corridors could also serve as funnels that increase predator efficiency and reduce survival of the individual prey species that are using the corridor (*Groom et al. 1999*). Corridors of 300 feet or greater are required under *ARM 36.11.403(20)(b)* and are assumed to allow adequate connectivity to the larger mammals that inhabit the project area, such as fishers (*Jones 1991*) and lynx (*Koehler 1990*). Riparian areas and ridges often play an extra important role in providing connective corridors throughout a landscape; in Swan valley riparian areas, riparian areas provide connectivity between the valley bottom and upper elevations.

Analysis Area and Methods

Effects to wildlife species were evaluated in terms of the amount of connective forest removed and effects to connectivity along major streams and ridges. Connective forest was identified using SLI data to select pole and sawtimber stands with semi-closed to closed canopies (40- to 100-percent canopy closure) that were greater than 300 feet wide. These stands would presumably provide movement corridors for wildlife species in the area. Changes to the existing condition that would occur with each alternative were assessed by removing any stands where the canopy would decrease below 40 percent after harvesting and reanalyzing the acreage of connective habitat. The Porcupine Woodward Grizzly Bear Subunit was used for the cumulative-effects analysis area. Connectivity throughout the subunit was qualitatively evaluated, with an extra focus on connectivity through the major drainages.

Existing Environment

In the project area, forest connectivity has been relatively well maintained. Currently, 4,403 acres (70 percent) of the project area provides habitats that would allow movement for forest-dwelling species. Very few of these acres are in isolated patches (*FIGURE W-1 CONNECTIVITY MAP*). Connectivity throughout the major drainages is also relatively intact.

Throughout the subunit, connectivity has been diminished in places due largely to the scattered ownership patterns where private industrial timberlands are interspersed with state and USFS lands. Forest connectivity is often broken in areas where large overstory-removal-type harvest units occur. Several sections in the Woodward and South Woodward drainage areas have experienced heavy overstory removal and subsequent reductions to forest connectivity within the last few decades. Along the major streams within the subunit, several breaks occur where forest cover is reduced to less than 300 feet. The majority of such breaks occur in Woodward and South Woodward creeks, whereas Whitetail and Porcupine creeks are more intact in terms of forest connectivity. Some of the breaks are a result of natural openings (wet meadows, shrub fields, avalanche chutes), though most result from harvest units. In most cases, these openings contain at least some horizontal cover from shrubs or regenerating trees, thereby providing some cover in the openings. The few open roads throughout the subunit can also impede connectivity for some species. In general, however, connectivity of forested habitats is fairly intact within the subunit.

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Connectivity***

  No short-term changes in forest connectivity would be expected under this alternative, as no harvesting or increases in road densities would occur. Over time, and in the absence of natural disturbances, forest connectivity could increase due to the successional conversion of early seral stands and sparse stands to older stands providing overhead forest cover. The increase in connectivity would benefit species that depend on dense interconnected forests by providing movement corridors between habitats in the project area. No-

FIGURE W-1 - CONNECTIVITY MAP. Patches of forest that would provide connective habitat for wildlife species (shown in green) within the project area (outlined in red). Noncover areas are shaded in gray. A minimum of a 300-foot no-harvest buffer would be used on each of the main streams for each action alternative (not visible at this scale).

No-Action Alternative A	Action Alternative B	Action Alternative C	Action Alternative D

Action Alternative A would result in no short-term effects and slightly positive long-term effects to forested connectivity in the project area.

- ***Direct and Indirect Effects of Action Alternative B to Connectivity***

This alternative would result in a 19.8-percent reduction of connective forest (*TABLE W-3 - CONNECTIVITY*). Due to the dispersed nature of harvesting associated with this alternative, overall forest connectivity would be minimally affected. Very little harvesting would occur along important corridors, such as streams and ridges, except in Section 16 near the top of Woodward Creek. Connectivity along this corridor would be decreased, though mitigations that involve leaving a 150-foot no-cut buffer on either side of the stream would allow for a corridor of adequate size to facilitate travel through this area. Mitigations would also be in place to provide connectivity between patches of dense forest in the western portion of Section 2, where heavier retention would be prescribed along the ridge. Under Action Alternative B, connectivity would be affected the greatest in the northernmost and southernmost parts of the project area, mostly in upland areas (*FIGURE W-1 - CONNECTIVITY MAP*); good connectivity would be retained in Whitetail Creek; and only minor effects would occur to other drainages. Therefore, because: 1) the amount of connective forest would be reduced by 871 acres, and 2) connectivity would be well maintained along the major drainages and ridgelines, minor effects to connectivity for wildlife species in the project area would be expected.

- ***Direct and Indirect Effects of Action Alternative C to Connectivity***

Under this alternative, connectivity would be reduced by 22.7 percent in the project area (*TABLE W-3 - CONNECTIVITY*), with the reductions occurring in the 5 sections where harvesting would take place. Large patches of mature, full-canopied forest would be converted to early-successional stages that would not provide connectivity for wildlife species that prefer dense forest for movement. Mitigations to retain adequate cover along ridgelines and saddles would help offset potential effects to connectivity between drainages (especially in Section 2, where heavier retention would be prescribed to maintain a connective corridor between patches of old growth and mature forests). Along the Whitetail Creek corridor, seedtree harvests would occur on one or both sides of the stream for the entire length of stream that runs through DNRC-managed lands in Sections 34 and 26 (approximately 2.6 miles), compromising the integrity of this drainage as an effective corridor for wildlife travel (*FIGURE W-1 - CONNECTIVITY MAP*). Mitigations to off-set the potential effects to connectivity along Whitetail Creek would include ensuring a buffer at least 300 feet wide that would be more or less centered on the stream. These no-cut buffers would allow wildlife movements to continue, which for the most part are centered within 100 to 150 feet of the stream channel. Therefore, this alternative would impact connectivity throughout the uplands in several areas, but would maintain the integrity of travel corridors centered near Whitetail Creek. This alternative would not impact the other major drainages in the project

***TABLE W-3 - CONNECTIVITY.** Effects to connective forest habitats in the project area as a result of each alternative. Connective forest is defined as areas of sawtimber or pole-sized forests with at least 40-percent canopy and at least 300 feet wide, which should allow movement for species that are hesitant to cross openings.*

	ALTERNATIVE			
	A	B	C	D
Acres of connective forest removed	0	871	1,001	821
Percent reduction in connective forest	0	19.8	22.7	18.6
Acres of connective forest remaining	4,403	3,532	3,402	3,582
Percent of project area remaining as connective forest	69.9	56.1	54.0	56.9

area. Therefore, because: 1) the connective forest would be reduced by 1,001 acres, and 2) connectivity would be impacted, but not severed, in the Whitetail drainage and other drainages in the project area would not be affected, moderate effects to wildlife connectivity within the project area would be expected, with the majority of the risk occurring in the Whitetail Creek corridor.

- ***Direct and Indirect Effects of Action Alternative D to Connectivity***

The dispersed nature of harvesting that would occur under this alternative would result in an 18.6-percent reduction in connective forest throughout the project area (*TABLE W-3 - CONNECTIVITY*). In the eastern part of Section 16 along Woodward Creek, connectivity would be slightly decreased, though leaving a 150-foot no-cut buffer on either side of the stream would allow for an adequate-sized buffer to facilitate travel through this area. Upland habitats in other parts of the project area would be affected (*FIGURE W-1 - CONNECTIVITY MAP*), but connectivity would be retained in Whitetail Creek, and little effects would occur to other drainages or ridges. Thus, because: 1) connective forest would be reduced by 821 acres, and 2) connectivity along major drainages and ridges would be retained, this alternative would result in minor negative effects to wildlife connectivity in the project area.

- ***Cumulative Effects of No-Action Alternative A to Connectivity***

Cumulative effects associated with this alternative would be negligible. Within the Porcupine-Woodward Subunit, several factors have influenced forest connectivity in the past, including timber harvesting, open roads, and natural disturbances such as fires or insect/disease outbreaks. Future actions on DNRC-managed lands could include up to 450 acres of disturbance due to sanitation and salvage projects (see *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER I*), but these activities rarely decrease canopy below 40 percent and, thus, do not appreciably affect the amount of connective forest. Precommercial thinning should not affect connectivity, as the stands currently consist of sapling-sized trees and do not have a well-developed overstory canopy that provides security for species that are hesitant to cross openings. Future activities outside of DNRC's control could further affect connectivity, including wildfires or timber harvesting on USFS and private lands. However, given the current knowledge of past and future actions in the subunit, connectivity within the area should remain fairly intact. Therefore, because connectivity in the analysis area would not be affected under this alternative and only minimally affected by foreseeable future actions, negligible effects to forested connectivity for wildlife species would be expected.

- ***Cumulative Effects to Connectivity Common to Action Alternatives B, C, and D***

  In addition to timber harvesting and road use associated with the project, other activities have or could affect forested connectivity within the Porcupine-Woodward Subunit. Future and recent past actions on DNRC-managed lands could include up to 450 acres of sanitation and salvage projects (see *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER I*), but these activities rarely decrease canopy below 40 percent and, thus, do not appreciably affect the amount of connective forest. Precommercial thinning should not affect connectivity, as the stands currently consist of sapling-sized trees and do not have a well-developed canopy that provides security for species that are hesitant to cross openings. Future activities outside of DNRC's control could further affect connectivity, including wildfires and timber harvesting on USFS and private lands, but DNRC is currently unaware of any plans for actions that would decrease connectivity. However, given the current knowledge of past and future actions in the subunit, connectivity within the area should remain fairly intact. Therefore, although connectivity would be reduced by 821 to 1,001 acres in the project area, connectivity would be reasonably well retained along major drainages and ridges throughout the cumulative-effects analysis area; thus, all action alternatives would result in minor negative cumulative effects to wildlife species.

LINKAGE

Issue - The proposed activities could reduce forested cover, which could adversely affect habitat linkage for wildlife.

Introduction

Linkage zones are defined as "the area between larger blocks of habitat where animals can live at certain seasons and where they can find the security they need to successfully move between these larger habitat blocks" (*Servheen et al. 2003*). Linkage zones differ from corridors in that the area is not just used for travel. Areas appropriate for linkage zones can occur at different spatial scales, particularly when considering the species of concern. For example, a linkage zone for a stream-breeding salamander may be the upland habitat between 2 first-order streams, whereas the linkage zone for a grizzly bear may be the large valley bottom between 2 mountain ranges. Increased linkage potential is found in areas with lower road densities, low densities of human-developed sites, higher vegetative hiding cover, and abundant riparian areas (*Servheen et al. 2003*).

In this analysis, linkage is discussed in terms of factors that would allow linkage for a variety of large terrestrial wildlife species. The analysis is inclusive of grizzly bears, for which linkage zones were delineated in the SVGBCA. However, the analysis intends to include other terrestrial wildlife species. Additional information on linkage as it pertains specifically to grizzly bears is addressed later under *THREATENED AND ENDANGERED SPECIES*.

Analysis Area and Methods

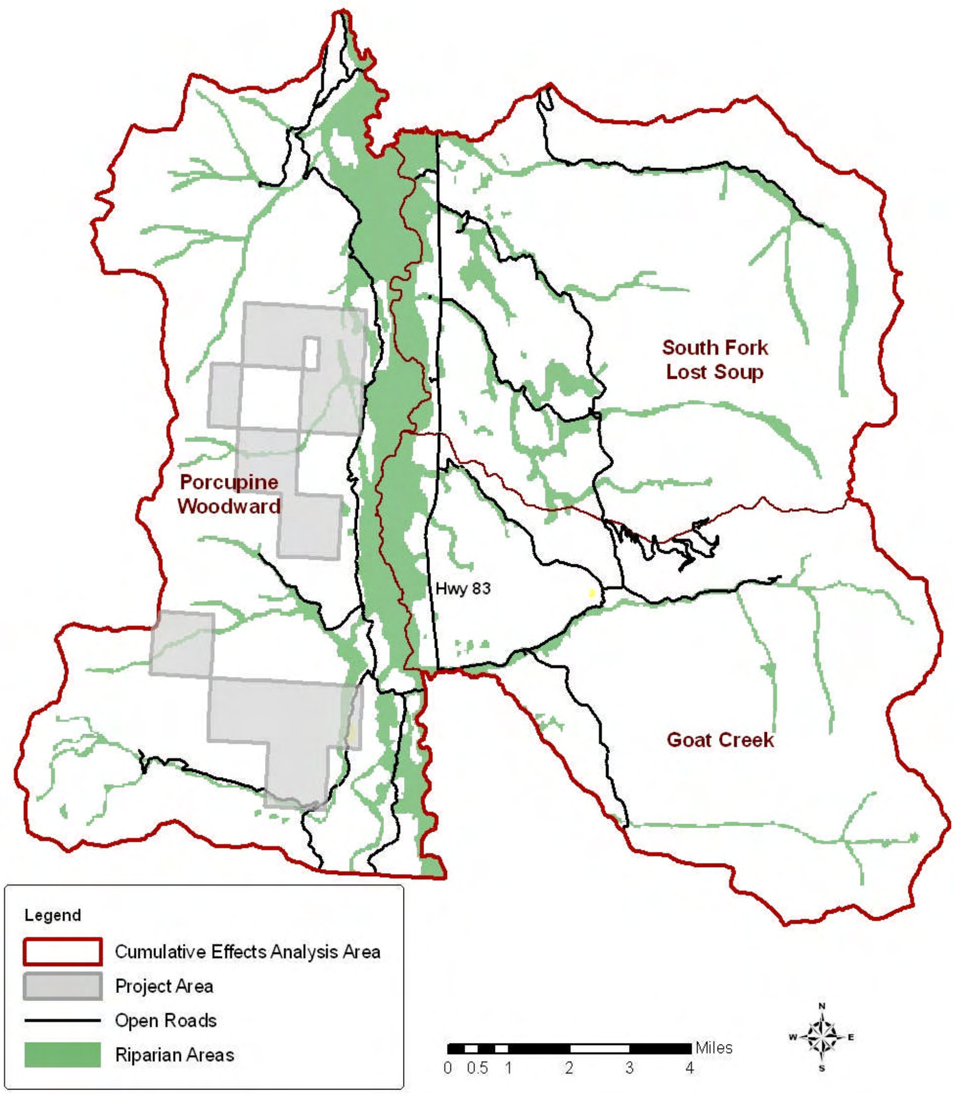
Three measurement criteria were used to qualitatively assess existing and predicted future-linkage potential under each alternative: 1) open-road densities and road usage, 2) human development, and 3) vegetative hiding cover (as defined in the SVGBCA - see *GRIZZLY BEAR* analysis below). Because the abundance of riparian areas would not change with any of the alternatives, and because all alternatives include measures to provide protection for riparian area, riparian areas were not included as a measurement criterion for linkage. Direct and indirect effects were considered within the project area. Because large terrestrial species were used as focal species for determining the effects of the proposed project to linkage, a large analysis area was used to examine cumulative effects of the proposed alternatives, including the Porcupine-Woodward, Goat Creek, and South Fork Lost Soup subunits (*FIGURE W-2 - LINKAGE*). The area provides linkage between the Mission Mountains to the west and the Swan valley bottom to the east.

Existing Environment

Linkage potential within the project area is currently very good, as no human development exists and riparian areas are abundant and heavily vegetated. Additionally, open-road densities in the project area are low, presenting few hindrances to linkage. Cover is dense in the majority of the project area, with 5,728 acres of hiding cover (91 percent of the project area).

Within the cumulative-effects analysis area, linkage values are also high, though some features exist that depreciate linkage potential. Highway 83, a two-lane road with little shoulder and a 70 mph speed limit, can hinder linkage potential, as some species are hesitant to cross the highway and vehicle-related mortalities to wildlife are fairly common. Within the Goat Creek, Porcupine-Woodward, and South Fork Lost Soup subunits, the proportion of the subunits with open-road densities greater than 1 mile per square mile are 27, 30, and 31 percent, respectively (*SVGBCA Monitoring Team 2007*). Although open roads can depreciate linkage value, the open-road densities in the analysis area are fairly low and, thus, provide little hindrance to linkage value. Human development is relatively low within the cumulative-effects analysis area, with scattered homes and other buildings located near the highway, but with little human development outside of the valley bottom. However, a subdivision of private lands into fourteen 20-acre parcels (Section 3, T23N, R18W) was recently proposed within the cumulative-effects analysis area, which could negatively impact linkage in the local area. Riparian areas are abundant within the analysis area and are protected in accordance with the SVGBCA and other State and Federal regulations. Vegetative hiding cover is also regulated by the SVGBCA and must remain at 40 percent or more within each grizzly bear subunit. According to the 2006 Swan Valley Conservation Agreement Monitoring Report, cover on state, Plum Creek, and USFS lands within the subunits ranges from 46 to 83 percent. Thus, the analysis area currently provides suitable linkage habitat for wildlife species.

FIGURE W-2. LINKAGE. Cumulative-effects analysis area for evaluating effects of the proposed alternatives to linkage habitat for wildlife species.



Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Linkage***

No changes would occur to open or temporarily open road densities on DNRC-managed lands. Riparian areas would not be further affected, and no changes in human development within the project area would occur. Cover could be affected over time as disease-infected and/or insect-infested trees die and, thus, reduce canopy closure, but these effects should be negligible as downfall and regenerating trees could provide some cover. Therefore, because open and total road densities would not increase, human development would not increase, and cover would not be affected, no effects to wildlife linkage would be expected.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Linkage***

Under any of the action alternatives, open-road densities would not increase in the project area. However, 14.0, 9.5, or 11.2 miles of permanent restricted roads would be built in the project area with Action Alternative B, C, or D, respectively. Use of restricted roads would also be expected to increase with both administrative and commercial usage associated with the timber sales. Most of this increase would occur within the 3-year operating window in the subunit or in winter months. Human development would increase very slightly with the building of a 22-acre gravel pit along an open road, although this type of disturbance is fairly low-risk compared with developments such as houses, campgrounds, etc. Harvesting under these alternatives would have minimal effects to riparian areas, as all streams would be buffered with 50- to 150-foot no-cut zones. Cover would be reduced on 1,614, 1,734, or 1,235 acres depending on alternative (see *GRIZZLY BEAR* below), which could deter movement or habitat use for species that prefer dense cover. However, a majority of the project area (65 percent for Action Alternative B, 63 percent for C, or 71 percent for D) would still retain hiding cover. Thus, because 1) open-road densities would not increase, but road usage would temporarily increase and total road densities would slightly increase, 2) disturbance would slightly increase with development and operation of a gravel pit, and 3) hiding cover would decrease by 21.6 to 28.2 percent, moderate short-term and minor long-term negative effects to linkage would be expected under any of the action alternatives.

- ***Cumulative Effects of No-Action Alternative A to Linkage***

Within the cumulative effects analysis area, changes to linkage have occurred in recent years with timber sales on state, Plum Creek, and USFS lands. Recent, present, and future small salvages, thinnings, and other projects on DNRC-managed lands could potentially increase the intensity of road use (see *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER I*), but would not increase the density of open roads. Cover within the Porcupine-Woodward Subunit would remain the same in the analysis area (79.6 percent), with the exception of changes that are occurring as a result of harvesting with the Three Creeks Timber Sales; remaining cover in the South Fork Lost Subunit will be 75 percent after harvesting (*DNRC 2006*). However, given the past, current, and future actions within the analysis area, the cumulative effects to linkage would be negligible under No-Action Alternative A, as this alternative would have no effects on open-road densities, human development, cover, or riparian areas.

- ***Cumulative Effects to Linkage Common to Action Alternatives B, C, and D***

Previous timber sales on state, Plum Creek, and USFS lands in the analysis area have affected open and total road densities and forest cover. Future small sales and salvage projects on DNRC-managed lands could potentially increase the intensity of road use, but would not increase the density of open roads. Cover would vary little between all action alternatives, and amounts postharvest in the Porcupine-Woodward Subunit would range from 74.2 to 75.6 percent from the existing level of 79.6 percent (see *GRIZZLY BEAR* analysis below). Remaining cover in the South Fork Lost Subunit will be 75 percent after harvesting associated with the Three Creeks Timber Sales (*DNRC 2006*). Other actions in the analysis area that could affect linkage could include timber management on private, Plum Creek, or USFS lands and the associated effects to cover and road usage, though no plans for such actions are known at this time. Human development is likely the biggest risk to linkage, as habitats become permanently unsuitable for wildlife and possibilities for human-wildlife interactions increase. Thus, the effects of human disturbance associated with the gravel pit would be additive to disturbance increases that could occur with the proposed subdivision of private lands into fourteen 20-acre parcels in Section 13, T23N, R18W. However, risks to wildlife attributable to unnatural foods and associated habituation to humans and the likelihood of human-wildlife encounters would be low for the gravel pit, because no human dwellings would be involved. Also, because of its location near an open road (a source of regular disturbance) and the fact that no unnatural foods would be stored at the gravel pit location, additional risks to wildlife would be much lower than for a subdivision containing multiple permanent human dwellings. At the scale of the cumulative-effects analysis area, which encompasses a large linkage area between the Swan and Mission mountain ranges, no discernable differences between alternatives would occur in their level of cumulative effects to habitat linkage. Therefore, because the proposed action alternatives would similarly 1) increase total road densities and commercial road usage in parts of the cumulative effects analysis area, though not increase open road densities, 2) increase human disturbance with the development of a low-use gravel pit, and 3) minimally decrease cover within the cumulative effects analysis area, some negative cumulative effects to linkage would be expected, but the overall linkage value within the cumulative-effects analysis area would still be expected to be high due to the small relative amounts of change attributable to any action alternative.

PATCH SIZE AND FRAGMENTATION

Issue - The proposed activities could result in changes in patch size and shape and cause fragmentation of interior forest habitat.

Introduction

Habitat fragmentation refers to the landscape-level process in which a specific habitat is progressively subdivided into smaller and more isolated patches (*McGarigal and Cushman 2002*). Historically, wildfires were a primary disturbance factor that shaped the forests of western Montana (*Fischer and Bradley 1987, Arno et al. 1995, Losensky 1997*). Thus, substantial portions of forested landscapes were fragmented naturally (*Gruell 1983, Hart 1994*), and many species native to Montana that use forested habitats evolved under conditions where substantial amounts of available habitat occurred in relatively small, isolated patches. However, human management of landscapes, especially those in which ownership is mixed, has generally increased the patchiness of forested habitats.

In general, timber harvesting can decrease patch size and change the shape and amount of fragmentation among patches of dense forest. Landscape-level management that can mitigate the effects to wildlife species while still harvesting timber includes principles such as limiting the creation of small habitat islands where interior forest-associated species may suffer localized extinctions of small subpopulations, treating and retaining fewer larger patches rather than many small ones, and reducing edge (boundary between habitats perceived by an organism to be substantially different from one another) to reduce effects of nest parasitism of some bird species and elevated levels of predation on some species associated with edge habitat, since large patches tend to have less edge per unit area than small patches.

The effects of fragmentation are often confounded by the subsequent loss of habitat (*Fahrig 2002, McGarigal and Cushman 2002*). In this analysis, fragmentation of forested patches will be discussed separately from issues of habitat loss (see *COVERTYPE*, *AGE CLASS* and *OLD GROWTH* for discussions of effects of changing habitat amounts). Numerous metrics can be used to describe landscape patterns; for example, the program FRAGSTATS can calculate over 50 metrics to describe landscape patterns. However, data overload is quite possible and, thus, the responsibility of the individual researcher is to determine which metrics are most pertinent and best describe the landscape in question (*McGarigal and Marks 1995*). The ecological effects that are of most concern or risk regarding this project are the potential to create small ineffective patches or an increase in edge habitats that subsequently harm species associated with interior forest. Thus, this discussion will focus on the sizes of patches of dense forest habitat and the amount of edge between dense forest and nonforested or sparsely-forested habitats.

Analysis Area and Methods

"Dense forest" was identified using SLI data to select patches of pole and sawtimber stands with semi-closed to closed canopy (40 to 100 percent canopy closure). To assess the existing sizes and edges of dense forest patches in the project area, ArcGIS 9.2 was used to calculate the acreage of patches and the miles of edge habitat (defined as the total summed amount of linear perimeter in miles for each dense pole and sawtimber patch). Changes to the existing condition that would occur with each alternative were assessed by quantifying the changes in the existing acres and associated miles of edge habitat. Any harvest units that would result in less than 40-percent canopy postharvest were removed from the dense forest category. Measurement criteria included changes in sizes of patches of dense forest habitat and the amount of edge between dense forest and nonforested or sparsely-forested habitats. To allow consistency of discussion with the patch-size analysis in *AGE AND COVERTYPE PATCH SIZE* in *VEGETATION ANALYSIS,* cumulative effects of fragmentation and patch size were qualitatively assessed across Swan River State Forest.

Existing Environment

Within the project area, patch sizes are generally smaller than in historic times (see *AGE AND COVERTYPE PATCH SIZE* in *VEGETATION ANALYSIS*). These conditions have most likely increased habitat for species that use a diversity of age classes or thrive on edge habitats, while decreasing habitat for species that require large patches of habitat of a certain age. Dense forest patches (canopy of 40 percent or greater with pole or sawtimber stocking), presently range from 12 to 1,953 acres, with an average of 679 acres (*TABLE W-4 - PATCH SIZE*). Approximately 75 percent of the dense forest patches are greater than 100 acres in size. Currently, 31.2 miles of edge habitat are associated with dense forest patches.

In the Swan valley landscape overall, forest patches comprised of mature and overmature trees have become much smaller and more fragmented over the past 60 years (*Hart 1994*). Across the cumulative-effects analysis area (Swan River State Forest), patch sizes on DNRC-managed lands are generally smaller than historic patches were (see *AGE AND COVERTYPE PATCH SIZE* in *VEGETATION ANALYSIS*). Average sizes for dense forest patches on DNRC-managed lands in the cumulative-effects analysis area are 400 acres, ranging from 2 to 11,185 acres, and 50 percent are larger than 100 acres. Edge habitats associated with dense forest patches total 257 miles. Smaller patch sizes are largely attributable to past harvesting and logging practices that have been ongoing for decades on state, USFS, and corporate timberlands and the lack of large-scale wildfires in Swan Valley in recent times. Past harvesting on USFS and Plum Creek lands has also affected the landscape patterns in terms of patches of dense forest. In general, large patches of dense forest are fairly abundant on USFS lands; however, few of such patches remain on Plum Creek lands in the cumulative-effects analysis area. These conditions have decreased habitat for species that require large patches of habitat of a particular age or size class, especially mature forest types.

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Patch Size***

  Patch size and perimeter distance associated with dense forest patches would not change in the short term in the project area (*TABLE W-4 - PATCH SIZE).*

TABLE W-4 - PATCH SIZE. Patch size of dense forest habits and amount of edge associated with dense forest patches in the project area and cumulative-effects analysis area.

	ALTERNATIVE			
	A	B	C	D
Project area				
Average patch size (acres)	679	351	229	387
Percent decrease in average patch size	0	48.3	66.3	43.0
Miles of edge	31.2	36.7	36.0	41.0
Percent increase in edge habitat	0	15.0	13.3	24
Cumulative-Effects Area (Swan River State Forest)				
Average patch size (acres)	400	362	342	375
Percent decrease in average patch size	0	9.5	14.5	6.3
Miles of edge	257	260	260	265
Percent increase in edge habitat	0	1.2	1.2	3.0

In the longer term, without substantial natural disturbance, patch size would likely increase in the dense forest patches and older age classes, while diversity of habitats and amount of edge would decrease. Species that use large blocks of closed-canopy forested habitats would not be further impacted by this alternative due to advances in succession. Thus, because 1) patch sizes of dense forest would not decrease, and 2) edge habitats would not increase, no negative and perhaps slight positive effects would be expected to wildlife species that are sensitive to these fragmentation effects.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Patch Size***

Dense forest patches would be fragmented throughout the project area under any action alternative, which could affect species that use larger patches of dense forest in several drainages. In general, the timber harvesting would increase the number of patches and decrease the patch size by 43 to 66 percent in the project area (*TABLE W-4 - PATCH SIZE*). Patches would generally have more edge, as edge would increase 13 to 24 percent. However, depending on the alternative, 7 to 8 of the remaining patches of dense forest would be large (greater than 100 acres), leaving habitat for species that need larger patches of dense forest. Therefore, because 1) the average patch sizes of dense forest would decrease, and 2) edge habitats would increase moderately within the project area, all of the action alternatives would be expected to have moderate negative effects to wildlife species that rely on large patches of densely forested habitat or that are sensitive to edge effects.

- ***Cumulative Effects of No-Action Alternative A to Patch Size***

Patch size, shape, and edge habitats would not change as a result of this alternative. Past harvesting and the effects of harvesting associated with the Three Creeks Timber Sales were accounted for in the analysis of patch sizes and shapes across Swan River State Forest. Other management actions that have occurred as a result of salvage and sanitation harvests and other small projects on Swan River State Forest could also affect patch size and edge for dense forest if the actions led to a decrease in stocking size class or canopy closure. These activities would be expected to cause little cumulative effects to fragmentation. Precommercial-thinning activities would not create further fragmentation, as these activities would occur in stands that are not currently considered dense forest patches. Otherwise, in the absence of additional natural disturbance events that would cause further fragmentation, the general trend over time would be for younger stands to grow into dense forest patches, thus, increasing overall patch size and decreasing edge habitats. Therefore, because this alternative would 1) result in no decrease in the size of dense forest patches, and 2) have no edge effect, no negative and perhaps slight positive cumulative effects to wildlife species would be expected.

- ***Cumulative Effects Common to Action Alternatives B, C, and D to Patch Size***

The average size of dense forest patches could decrease 6.3 to 14.5 percent, depending on which alternative was selected, and the amounts of edge could increase 1 to 3 percent (*TABLE W-4 - PATCH SIZE*). These figures account for past harvesting on Swan River State Forest, including the effects of harvesting associated with the Three Creeks Timber Sales. Past harvesting on USFS and Plum Creek lands has also affected the landscape patterns in terms of patches of dense forest. In general, large patches of dense forest are fairly abundant on USFS lands. However, few of such patches remain on Plum Creek lands in the cumulative-effects analysis area. Future actions that could further fragment dense forest patches would include the small permits and salvage projects planned for Swan River State Forest in the near future if the actions led to a decrease in the stocking size class or canopy closure. These activities would be expected to cause slight cumulative effects to fragmentation. Future harvesting on Plum Creek lands, though unknown at this point, could also further reduce patch sizes of dense forest. However, the longer-term effect would be the creation of larger patches of dense forest once the stands regenerate. Precommercial thinning on DNRC-managed lands would not create further fragmentation, as these activities would occur in stands that are not currently considered dense, mature forest patches. Overall, with any of the action alternatives, additional fragmentation in terms of 1) lowering the average patch size, and 2) increasing edge habitats would be cumulative to other activities on Swan River State Forest and would cause some slight negative effects to species that prefer large patches of dense forest habitat or that are negatively affected by edge habitats.

SNAGS

Issue - The proposed activities could reduce the number and distribution of snags, which could adversely affect species closely associated with these habitat attributes.

Introduction

Snags and defective trees (partially dead, spiked top, broken top) are used by a wide variety of wildlife species for nesting, denning, roosting, feeding, and cover. The quantity, quality, and distribution of snags affect the presence and population size of many of these species.

Snags provide foraging sites for insectivorous species and offer opportunities for primary cavity-nesting species to excavate nests. The cavities created by the primary excavators (i.e. woodpeckers) also provide habitat for secondary cavity users, including other birds and small and midsized mammals. Snags and defective trees can also provide nesting sites for secondary cavity users where cavities are formed by broken tops and fallen limbs. Without trees and snags that provide for cavities or substrate for cavity excavation, primary and secondary cavity species would not be able to survive and/or reproduce in the area. Primary risk factors include loss to legal and illegal firewood cutting, prescribed burning, removal for wood fiber, purposeful felling for human safety during timber harvesting operations, and incidental loss during logging due to equipment operation and yarding activities.

The tree species, diameter, height, decay stage, species, and densities of snags determine the snag-habitat value for wildlife species. Larger, taller snags tend to provide nesting sites, while shorter snags and stumps tend to provide feeding sites (*Bull et al. 1997*).

Many species that use the smaller diameter snags will also use large snags; however, the opposite is not true. Typically, older-aged stands will have greater numbers of large snags. Snags in early stages of decay are often used more for feeding substrates, while midlevel decay provides opportunities for cavity excavation (*Schepps et al. 1999*). Some species of trees decay at slower rates than others, thereby providing habitat for longer periods of time. For example, western larch, western white pine, and ponderosa pine are harder woods that decay less rapidly than Douglas-fir, subalpine fir, or Englemann spruce trees. Finally, snag densities are another important aspect of habitat value for cavity-nesting birds, as many of these species tend to nest in areas where snag densities are high, using one snag for nesting, but having others nearby for foraging or roosting opportunities.

Analysis Area and Methods

Information regarding the size, species, and density of snags was gathered by both qualitative assessments during site visits and quantitative assessments using precruise data collected in the fall of 2007, when at least 1 plots per stand was surveyed in 48 previously unharvested stands that are proposed for harvesting under the action alternatives. Snags were separated into medium (15 to 20.9 inches dbh) or large (21 inches dbh and greater). These 2 size classes of snags are emphasized in the analysis because they require the longest time to produce, they tend to stand longer than small snags, and they offer habitat substrate for a larger breadth of wildlife species. Data on snag densities in stands surveyed in the precruise efforts were averaged across the age classes surveyed, including 6 stands in the 100-to-149-year age class, 5 stands in the 150+-year-old stands that did not meet old-growth definitions, and 36 old-growth stands. Only one stand in the 40-to-99-year age class was surveyed, so its data was only included in calculating the overall average. Snag densities were also averaged by covertype, using data plots in 21 mixed-conifer stands, 5 western larch/Douglas-fir stands, and 22 western white pine stands. Other covertypes potentially affected by the action alternatives (lodgepole pine and subalpine fir) were not surveyed. Snag densities are also reported in the SLI data for each stand in the project area; however, these data are obtained less rigorously than the precruise data; thus, the precruise data show a better representation of actual snag densities in the proposed treatment stands. Findings of *Harris (1999)* were used as a coarse approximation of historical snag abundance for the purpose of numerical comparison.

Some of the stands selected for harvesting and, thus, were surveyed, exhibit, the highest levels of insect and disease effects of stands in the project area. However, other stands included in the survey show more moderate rates of mortality. In general, most of the older-aged stands in the project area contain numerous trees afflicted by insect and disease activities. Thus, extrapolating the average snag densities from the cruise plots to other unharvested stands in the project area should give a reasonable approximation of snag densities throughout the project area.

Effects of all alternatives to snag habitats were assessed in the project area, with consideration to the effects of each alternative on snag densities as well as the qualities of the remaining snags, in terms of species and size. Cumulative effects were assessed within the Porcupine-Woodward

Subunit, as this area would be large enough to support a diversity of species that use snag resources, from birds to small mammals and meso-carnivores. Estimates of the amount of land previously harvested in the subunit were based on data from DNRC and USFS regarding harvest histories, and photo interpretation of Plum Creek lands. These data include information on large timber sales, but may not incorporate all small salvage projects.

Existing Environment

Average densities of medium and large snags in stands surveyed in the project area were 8.8 and 3.4 snags per acre, respectively. Older stands had more large snags per acre in general than the younger aged stands, though variation was high in the 150-year-plus age class (*FIGURE W-3 - SNAGS BY AGE*). Western white pine stands had the highest large-sized snag densities (*FIGURE W-4 - SNAGS BY COVERTYPE*). Data from the precruise plots as well as from field observations indicate that a variety of snag species exist within the proposed treatment areas. According to the precruise data the most common snag species in the large size class were Douglas-fir and western larch, . Grand fir, western white pine, subalpine fir, and Engelmann spruce snags were also observed; the level of decay varied from very recently-killed snags with little outward sign of decay to snags in advanced stages of decay, from which bark had peeled, tops had broken, and rot was evident.

Nearly all stands in the project area and most within the cumulative-effects area are categorized in either the "warm and moist" or "cool and moist" habitat type groups (*Green et al. 1992*). For an approximate historical reference, *Harris (1999)* estimated that snag densities in these habitat groups, respectively, were 3.9 and 2.4 snags per acre for medium-sized snags and 1.2 and 0.9 snags per acres for large-sized snags in western Montana. The abundance of snags in 100-year-plus stands in the project area reflects the lack of recent harvesting or other

FIGURE W-3 - SNAGS BY AGE. Average snag densities by age class, from precruise surveys of 48 previously unharvested stands in the project area; bars represent mean dbh and 95-percent confidence intervals.

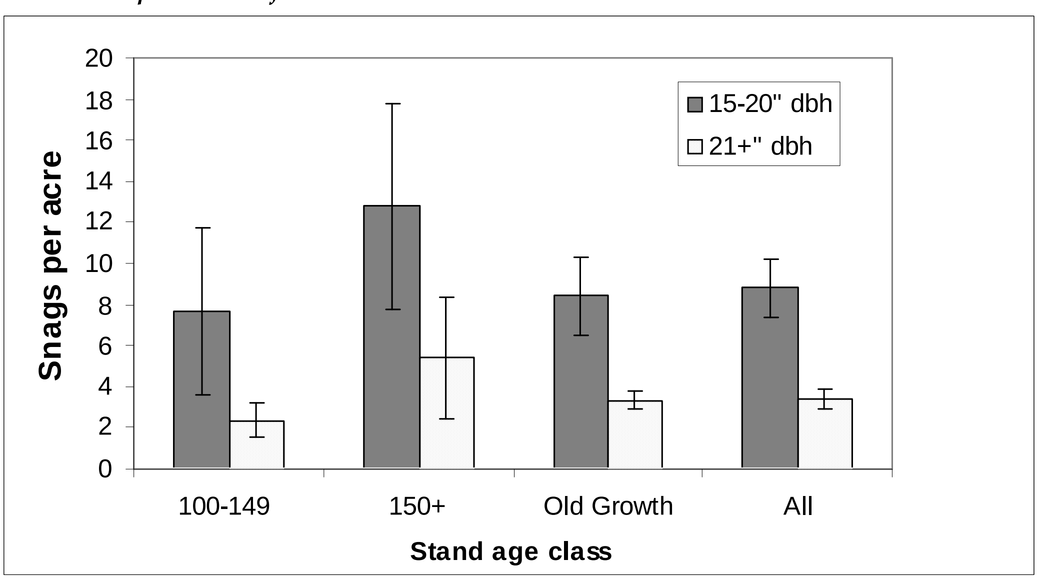
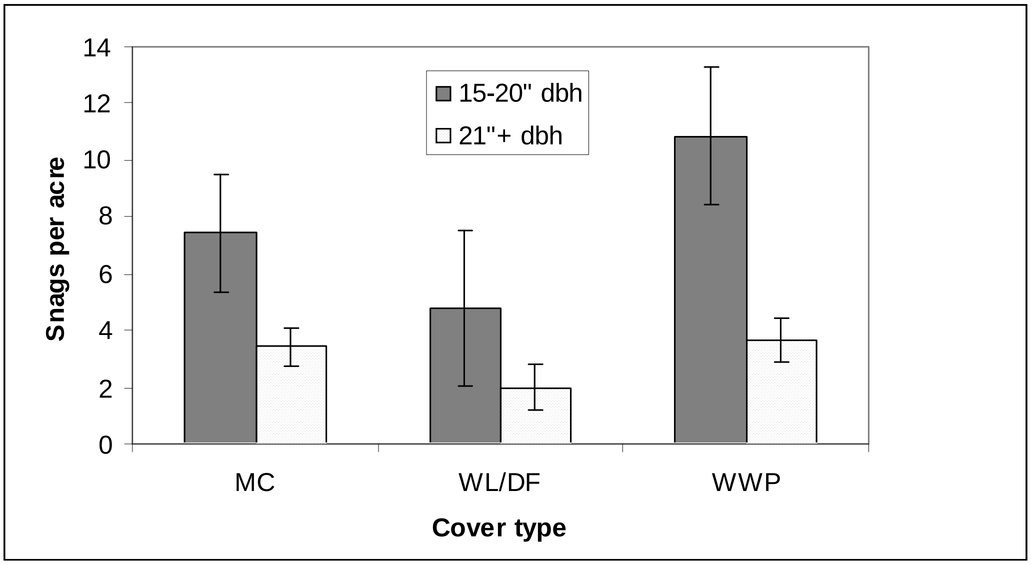


FIGURE W-4 - SNAGS BY COVERTYPE. Average snag densities by covertype, from precruise data in the project area; bars represent mean dbh and 95-percent confidence intervals.



disturbances, and also likely reflects the high degree of insects and diseases that are causing tree mortality.

Although older stands in the project area may have higher snag densities than were historically present, younger stands are most likely below the historical snag densities, as younger stands historically would have had snags created by fire or insects/diseases that would remain after the disturbance. Although agencies and private landowners now attempt to retain snags and snag-recruitment trees in harvest units, the practice of doing so was not common throughout much of the last century.

Snag densities in stands that have been harvested within the last century are lower than in unharvested stands (based on visual estimates and SLI data), as the practice of leaving snags and snag recruits was not common throughout much of the last century. Snag densities are also reduced near open roads, where snags are often cut for firewood. Thus, approximately 2,146 acres (34 percent) of the project area have low snag densities (maximum average of 2 large snags per acre, but likely less; *TABLE W-5 - SNAGS AND COARSE WOODY DEBRIS).* Similarly, approximately 44 percent of the cumulative-effects area consists of stands that likely do not have an abundance of large snags because of past harvesting or their proximity to roads.

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Snags***

  This alternative would result in negligible short-term changes in snag density or diversity, which would benefit or retain current habitat for species that use snag resources for wildlife. In the project area, snags would remain in high densities on the 4,149 acres of forest that have not been harvested and are not near open roads. In the longer term, shade-intolerant snag species would be expected to decline and not be replaced due to the lack of reproduction of these tree species without

TABLE W-5 - SNAGS AND COARSE WOODY DEBRIS. Acres of DNRC-managed lands with estimated high densities of medium- and large-sized snags and coarse woody debris in the project area and the cumulative-effects analysis area. Criteria for selection of included lands not harvested in the last century and more than 200 yards from open roads.

	ALTERNATIVE			
	A	B	C	D
Acres in project area	4,149	2,629	2,584	2,962
Percent of project area	65.9	41.8	41.0	47.1
Acres in cumulative-effects analysis area (subunit)	21,054	19,534	19,489	19,867
Percent of cumulative-effects analysis area	56.0	51.9	51.8	52.8

disturbance. Shade-tolerant species would be expected to contribute largely to snag densities; however, since the length of time between shade-tolerant species becoming soft enough for cavity excavation and the time they fall to the ground is relatively short compared to shade-intolerant species, the length of time that these snag species would provide secondary cavity-nesting habitat would be relatively short term. Therefore, because 1) snag densities would not decrease and would likely increase over time, and 2) a diversity of snags would exist, no negative effects and slight positive effects to wildlife species that use snag resources would be expected under this alternative.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Snags***

In all units proposed under the action alternatives, snag densities would be decreased across 1,187 to 1,565 acres from the current average of 3.4 large snags per acre to a minimum average of 2 large snags per acre; medium-sized snags would be retained if large snags are not available. The effects to wildlife species that utilize snag resources would be a decrease in the amount and distribution of snags across the harvest units and, thus, a reduction in the amount or quality of feeding and nesting habitats. A minimum of 2 large (21 inches or larger) snags and 2 snag recruits (21 inches or larger live trees) per acre would be retained in all harvest units, with preference given to the shade-intolerant species, as these typically provide habitat for longer periods of time than do the faster-decaying shade-tolerant species. If adequate densities of preharvest snags are lacking, snags in the next largest size class would be retained to meet *ARM 36.11.411*. These retention snags and live trees could provide limited feeding substrates in the near term, but would mostly function to provide for structural diversity once the stands regenerate to a closed-canopied forest again (approximately 80 to 100 years in seedtree or shelterwood units and 20 to 50 years in variable thin units). All action alternatives would retain over 2,500 acres of mature stands 100 years old or older with dense canopies (*TABLE W-5 - SNAGS AND COARSE WOODY DEBRIS*) in which snag densities are likely to approximate those observed in the precruise surveys, which would provide abundant habitat for a variety of wildlife species in the project area. Thus, because 1) snag densities would be decreased on 1,187 to 1,565 acres and 2) a diversity of snag sizes and types would remain on unharvested sites while high quality snags and recruitment trees would be retained in harvest units, habitat would be reduced for species that use snag resources, but the overall effects would cause minor negative effects to wildlife in the project area.

- ***Cumulative Effects of No-Action Alternative A to Snags***

  Snag densities would not be affected under this alternative; however, snag densities would likely continue to exist at lower levels near open roads due to firewood cutting and within salvage sales within the subunit. DNRC has recently conducted, and plans in the near future to conduct, salvage and small timber permit sales according to the precruise data *(RELEVENT PAST PRESENT AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER I)* that have reduced or would reduce snag densities to 2 snags and 2 snag recruits per acre on approximately 450 acres in the subunit. DNRC is unaware of any planned activities on other land ownerships in the subunit that would decrease snag densities or diversity. Thus, over 21,000 acres (56 percent) of the subunit would remain in an unharvested state where snag densities would be high, which would provide abundant resources for wildlife species that utilize snags. Therefore, because additional losses of snags would not occur under this alternative and the size and species composition would remain diverse in the analysis area, no cumulative effects to wildlife species would be expected.

- ***Cumulative Effects to Snags Common to Action Alternatives B, C, and D***

  Snag densities would be reduced from 3.4 large snags/acre to a minimum of 2 large snags per acre on the 1,187 to 1,565 acres associated with the action alternatives, as well as up to 450 acres of DNRC-managed lands within the subunit associated with salvage or sanitation projects that have recently been conducted or are planned for the near future. Medium-sized snags may be retained in places, but loggers are not contractually required to retain these snags unless large snags are not abundant enough to meet the minimum requirements of 2 snags per acre; if there are not enough large snags, smaller snags can be left. These reductions in snag resources would be additive to those that have occurred in the analysis area as a result of timber sales, salvages, and other associated activities over the last century. In the cumulative-effects analysis area (Porcupine Woodward Subunit), harvesting has occurred in approximately 44 percent of the stands in the last century, resulting in low densities of medium and large snags in these areas. Additional salvaging has occurred as well, though mostly in small pockets, and has not changed the stand age; however, snags are most likely less prevalent in areas that have been salvaged. High densities of snags would exist in the older, unharvested stands that would comprise approximately half of the subunit after harvesting under any of the action alternatives (*TABLE W-5 - SNAGS AND COARSE WOODY DEBRIS*). No future actions are planned on USFS lands in the subunit; thus, snags would not be removed and would likely continue to increase in density over time on USFS lands. Likewise, snag densities would continue to increase on nonharvested DNRC-managed and Plum Creek lands within the subunit. Future harvesting on Plum Creek lands in the subunit could further reduce snag resources, though the effects would be fairly minimal as most of the Plum Creek lands in the subunit have been harvested within the last century and likely already have low snag densities. No appreciable differences in cumulative effects of any of the action alternatives would be expected. The reduction in snags expected under any action alternative, in addition to the effects of ongoing firewood cutting and potential future logging on Plum Creek and other private lands within the cumulative-effects analysis area, would likely not affect the ability of the area to support a diversity of wildlife species that require snag structure. Therefore, considering 1) snag densities and diversity would be reduced to low levels (i.e., 2 large snags per acre) on 1,187 to 1,565 acres in addition to other activities in the cumulative effects analysis area that have affected snag resources, and 2) at least 50 percent of the cumulative-effects analysis area would be expected to have high densities of large and medium-sized snags, the cumulative effects to wildlife species closely associated with snags is expected to be minor.

COARSE WOODY DEBRIS

Issue - The proposed activities could reduce levels of coarse woody debris, which could adversely affect species closely associated with these habitat attributes.

Introduction

Coarse woody debris provides structural diversity and promotes biological diversity by providing habitat for many wildlife species. Many small mammals require coarse woody debris to survive. In turn, these species distribute fungi that are beneficial for seedling establishment and tree growth (*Graham et al. 1994*). Additionally, coarse woody debris can provide feeding substrates for species such as pileated woodpeckers and black bears, as logs will often host high densities of insects (*Aney and McClelland 1985*). Forest carnivores such as pine marten and Canada lynx rely on coarse woody debris to provide resting and denning habitat (*Patton and Escano 1985, Squires et al. in press*).

The quality and distribution of coarse woody debris can affect habitat quality for wildlife species that rely on it to meet various life requisites. Longer lengths of large-diameter downed wood typically provide higher-quality habitat for wildlife than do smaller and/or shorter pieces. Single scattered logs can provide lookout and travel sites, while log piles provide denning and resting habitat. Under natural conditions, logs tend to occur in patches or clumps, often where a blow-down event has occurred, with scattered lone logs occasionally distributed in between.

Analysis Area and Methods

Coarse woody debris was assessed qualitatively on site visits to the stands considered in this project and in neighboring stands via visual assessments in the field. Additional quantitative information was obtained via sampling plots to estimate amounts of coarse woody debris (see *GEOLOGY AND SOILS ANALYSIS* for more information). Effects of all alternatives to coarse woody debris were assessed within the project area, with consideration to the effects of each alternative on coarse woody debris densities, as well as the qualities of the remaining coarse woody debris in terms of size. Cumulative effects were assessed within the Porcupine-Woodward Subunit, as this area would be large enough to support a diversity of species that use coarse woody debris resources, from birds to small mammals and meso-carnivores. Estimates of the amount of land previously harvested in the subunit were based upon data from DNRC and USFS regarding harvest histories, and photo interpretation of Plum Creek lands. These data include information on large timber sales, but may not incorporate the small salvage projects.

Existing Environment

Presently, the project area contains many stands with moderate to high levels of coarse woody debris. Because of the high degree of insect infestations and disease infections in mature stands in the project area, coarse woody debris has accumulated as trees have died and fallen or blown over. These larger pieces of woody material on the forest floor provide feeding and denning habitat attributes for a variety of avian and mammalian wildlife species, especially those associated with mature forest types. During field visits, differing quantities of coarse woody debris were observed in stands in the project area, and the downed wood represented a range of sizes and decay. In older stands, coarse woody debris is fairly abundant. Stands that are 100 years or older and have not been harvested or salvaged in the last century represent 4,247 acres, or 67 percent of the project area. These older, unharvested stands likely contain an abundance of larger pieces of downed wood. In 3 old-growth stands surveyed, pieces of coarse woody debris that were at least 3 inches in diameter ranged from 12 to 27 tons per acre, with average diameters of 7 to 15 inches and a maximum diameter of 28 inches. In the 2 younger-aged stands surveyed, the coarse woody debris had smaller average diameters and lower densities of pieces 3 inches or greater in diameter (4 to 6 tons per acre). These 3 stands were harvested approximately 25 years ago. The practice of leaving woody debris was highly variable in the past and, to a large degree, often avoided on DNRC-managed lands until the last 10 years, as a clean forest floor was thought to be healthy. In more recent years, the practice of leaving coarse woody debris postharvest has become more common. However, while higher densities of coarse woody debris may often exist postharvest than preharvest, the number of large pieces (greater than 15 inches diameter) that are good for wildlife habitat are still fairly scarce (*DNRC 2005*). Hence, throughout the project area and the subunit, the amount of coarse woody debris in areas that have been harvested in the last century or are near roads could have varying densities of coarse woody debris, but likely do not have an abundance of larger logs that would provide habitat for wildlife, as these have rarely been left after harvesting and are often gathered for firewood. These areas make up about 34 percent of the project area and about 44 percent of the subunit (cumulative-effects analysis area; *TABLE W-5 - SNAGS AND COARSE WOODY DEBRIS*). However, the remaining 66 percent of the project area and 56 percent of the cumulative-effects analysis areas consist of stands that have not received substantial harvesting and are more than 200 feet from roads and, thus, support higher densities of coarse woody debris with many large-diameter materials, as evidenced by the plot data and visual assessments.

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Coarse Woody Debris***

  Moderate benefits to wildlife that use coarse woody debris would be expected under this alternative. In the short term, no changes in the amount, type, or distribution of coarse woody debris would be expected in the project area. Over time, coarse woody debris would increase in most stands due to trees dying and eventually breaking or falling over. Under this alternative, species that use coarse woody debris would maintain their currently high amounts of habitat and would, over time, gain habitat and/or benefit from improved habitat quality.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Coarse Woody Debris***

  Coarse woody debris, especially large, recently-fallen merchantable trees, could be removed from portions of acreages that range from 1,187 to 1,565 acres and would be harvested under the various action alternatives. For smaller animals, such as voles, squirrels, or other small mammals that rely on coarse woody debris, the differences in the effects of harvesting these different acres would be the most pronounced with Action Alternative C, followed by B, and then D. For larger animals, whose home ranges are much larger than the small mammals' home ranges, the effects of the various treatments may be less discernable, as each treatment would only be removing a portion of the total available habitat within the home range, rather than altering entire home ranges. However, approximately 15 to 20 tons per acre of coarse woody debris would be retained in the harvest units. In some cases, the total tonnage of coarse woody debris could increase through harvesting. Most of this material would consist of pieces of existing logs, cull boles, limbs, and tops; few intact trees would be retained. The coarse woody debris following harvesting would provide some wildlife habitat; however, species that use large pieces of coarse woody debris would likely lose a portion of their habitat components in the project area (*DNRC 2005*). The remaining acres of unharvested forests not near open roads would continue to provide habitat for species that utilize large pieces of coarse woody debris. Although the different alternatives would affect different acreages throughout the project area, 41 to 47 percent of the project area would be expected to retain high densities of high-quality pieces of coarse woody debris, including logs, whole trees, and large limbs, that have been created naturally. Therefore, some habitat may be removed or the quality reduced for species that rely on coarse woody debris, but the overall effects would cause low risk to wildlife species within the project area, as 15 to 20 tons per acre of coarse woody debris would be left on harvest units and many acres with high densities of coarse woody debris would not be harvested.

- ***Cumulative Effects of No-Action Alternative A to Coarse Woody Debris***

  Throughout the Porcupine-Woodward Subunit, cumulative effects would be negligible to potentially beneficial. Under this alternative, no harvesting would occur on DNRC-managed lands in the Porcupine-Woodward Subunit. However, salvage and sanitation harvesting planned on DNRC-managed lands in the near future may remove recently fallen trees from up to 450 acres *(RELEVENT PAST PRESENT AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER I)*. Timber harvesting that could occur on non-DNRC-managed lands in the analysis area could also affect the amount of habitat for species that use coarse woody debris, though no plans for such activities are known at this time. Thus, approximately 56 percent of the analysis area would remain in conditions that presumably support high densities of large, high-quality coarse woody debris; in time, more dead and dying trees would be expected to fall or blow over and increase the amount of habitat for wildlife species that use coarse woody debris. Therefore, because coarse woody debris density and quality would not decrease throughout the analysis area, no negative effects and slight positive cumulative effects to wildlife species would be expected.

- ***Cumulative Effects to Coarse Woody Debris Common to Action Alternatives B, C, and D***

Considering past, present, and future actions within the subunit, a low risk is that changes in coarse woody debris under each alternative could result in a substantial decrease in the survival or habitat values for wildlife species that require downed wood for their life requirements. Previous harvesting on state and other land ownerships in the subunit, especially those conducted before the South Woodward Timber Sale, often utilized broadcast burning to treat recently-harvested stands, which resulted in a scarcity of coarse woody debris in those stands that are now regenerated into the younger age classes. The effects from any of the alternatives would be additive to those of recent or future salvage projects on DNRC-managed lands that could remove large, solid down trees from up to 450 acres. No additional actions that could reduce coarse woody debris are known at this time (such as timber harvesting on private lands or a natural disturbance such as a fire). Losses of coarse woody debris due to firewood cutting would be expected to continue, mostly along open roads. Away from open roads, coarse woody debris recruitment would be expected to continue in nonharvested stands on both state and other land ownerships within the analysis area, especially in those stands that are in the 100-years-plus age class. Additionally, trees and snags retained in the harvest units would provide a source of coarse woody debris recruitment over time as they decay and fall over. Overall, all of the action alternatives would decrease the amount of land that would typically maintain relatively high amounts of coarse woody debris, but nearly half of the subunit should retain high densities of high quality coarse woody debris (*TABLE W-5 - SNAGS AND COARSE WOODY DEBRIS*). Although the amount of acres affected would differ between the action alternatives, no appreciable differences would exist between the alternatives with regard to their effects to species associated with coarse woody debris at the cumulative-effects analysis scale. Therefore, because the abundance of large pieces of woody debris would be decreased on harvested acres and past activities have decreased coarse woody debris in the cumulative-effects analysis area, any of the action alternatives would likely result in minor cumulative negative effects to wildlife species that use coarse woody debris resources.

FINE-FILTER ANALYSIS

In the fine-filter analysis, individual species of concern are evaluated. These species include wildlife species listed under the *Endangered Species Act of 1973*, species listed as sensitive by DNRC, and species managed as big game by DFWP.

THREATENED AND ENDANGERED SPECIES

In northwestern Montana, 3 terrestrial species are classified as "threatened" or "endangered" under the *Endangered Species Act of 1973*. The grizzly bear and Canada lynx are classified as "threatened," and the gray wolf is classified as "endangered". USFWS recently delisted the gray wolf (March 28, 2008); but a preliminary injunction (July 18, 2008) immediately reinstated Endangered Species Act protections to grey wolves in Montana. Since they were listed when the analysis began and there is uncertainty associated with potential federal lawsuits, they will continued to be considered "endangered" for this analysis.

- **Canada Lynx**

  Issue: Timber harvesting and associated activities could remove canopy closure or alter stand conditions, which could alter suitable lynx habitats, rendering them unsuitable for supporting lynx.

Introduction

Canada lynx are listed as "threatened" under the *Endangered Species Act*. Currently, no recovery plan exists for Canada lynx, but a draft recovery plan outline has been written (*USFWS 2005*) and is being further developed and considered by USFWS. Additionally, critical habitat has been proposed by USFWS, which includes portions of Swan River State Forest. However, since this proposal has not been finalized, critical habitat will not be discussed further in this analysis.

Canada lynx are associated with subalpine fir forests, generally between 4,000 to 7,000 feet in elevation in western Montana (*Ruediger et al. 2000*). The proposed project area ranges from approximately 3,160 to 6,200 feet in elevation and on DNRC-managed ownership is dominated by Douglas-fir/ western larch with appreciable acreage in mixed conifers, Engelmann spruce, lodgepole pine, and western red cedar. Lynx habitat in western Montana consists primarily of stands that provide habitat for snowshoe hares, either dense, young coniferous stands or dense, mature forested stands, as well as mature subalpine fir types with abundant coarse woody debris for denning and cover for kittens, and densely forested cover for travel and security. These conditions are found in a variety of habitat types, particularly within the subalpine fir series (*Pfister et al. 1977*). Historically, high intensity, stand-replacing fires of long fire intervals (150 to 300 years) occurred in continuous dense forests of lodgepole pine, subalpine fir, and Engelmann spruce. These fires created extensive even-aged patches of regenerating forest intermixed with quite old stands that maintained a mosaic of snowshoe hare and lynx habitat.

Analysis Area

Direct and indirect effects were analyzed for activities conducted in the project area. Cumulative effects were analyzed on the 37,614-acre Porcupine Woodward Grizzly Bear Subunit (per *ARM 36.11.435 (7) (a) & (b)*). This scale of analysis approximates the home range size of a lynx (*Ruediger et al. 2000*). More information regarding the Porcupine Woodward Grizzly Bear Subunit can be found under *GRIZZLY BEAR* in this analysis.

Analysis Methods

To assess lynx habitat, DNRC SLI data were used to map specific habitat classes used by lynx. Lynx habitat (*ARM 36.11.403(40)*) was assigned to a stand if the SLI data indicated habitat types (*Pfister et al. 1977*) that are consistent with those reportedly used by lynx (*Ruediger et al. 2000*). Other parameters (stand age, canopy cover, and amount of coarse woody debris) were used in modeling the availability of the following 5 specific lynx habitat elements:

1) denning,
2) young foraging,
3) mature foraging,
4) forested travel/other habitat, and
5) temporary non-lynx habitats.

Denning habitat provides important vegetative and woody structure needed to provide denning sites and security for juvenile lynx, while foraging habitat is critical for the survival of both adult and juvenile lynx. "Forested travel/other habitat" is a general habitat category that provides for secondary prey items and contains modest levels of forest structure usable by lynx. Temporary non-lynx habitat consists of non-forest and open forested stands that are not expected to be used by lynx until adequate horizontal cover reestablishes.

Factors considered in the analysis include landscape connectivity and the amount of the cumulative-effects analysis area in denning, foraging, and unsuitable habitats.

Existing Environment

Approximately 6,044 acres of lynx habitat occur (*TABLE W-6 – LYNX HABITATS*) in the 6,294-acre project area. Much of this habitat was identified as forested travel/ other and mature foraging habitats, with lesser amounts of denning and temporarily not available habitats. Connectivity of forested habitats within the project area is relatively intact (see *CONNECTIVITY* in this analysis).

At the scale of the cumulative-effects analysis area, mature foraging and forested travel/other suitable habitats dominate the Porcupine Woodward Grizzly Bear Subunit, with lesser amounts of denning and temporary nonhabitat (*TABLE W-6 – LYNX HABITATS*). The distribution of the various lynx habitat elements on DNRC-managed lands is the result, primarily, of past timber harvesting and the lack of recent wildfire. Forest-management practices over the past 40 to 60 years produced the current levels of temporary unsuitable and young foraging habitats. Stands that were precommercial thinned on DNRC-managed lands would be considered forested travel/other habitat and not young foraging habitat in accordance with the DNRC lynx-mapping protocol. Timber harvesting conducted over 15 years ago has likely recovered to the point of at least providing forested travel/other habitat. Although it appears there are not any young foraging habitats on DNRC-managed lands in the subunit, some of these younger stands that may be classified as forested travel/other habitats contain young foraging attributes and may support sufficient snowshoe hare densities to be suitable foraging habitats for lynx. In addition, the lack of fire, including the effects of fire suppression, led to the development and maintenance of mature foraging, forested travel/other, and denning habitats. *ARM 36.11.435 (7) (a) & (b*) require a minimum of 5 and 10 percent of the lynx habitats in a bear management subunit to be in denning and foraging habitats, respectively. Currently, the Porcupine Woodward Grizzly Bear Subunit exceeds the minimum thresholds for both foraging and denning habitat requirements (*TABLE W-6 – LYNX HABITATS*). Within the cumulative-effects analysis area, the ongoing DNRC Winter Blowdown Salvage Project would be expected to continue affecting up to 32 acres of lynx habitats, which are mostly forested travel/other habitats. Meanwhile activities associated with the DNRC's Low Wood Salvage 2 Permit would continue converting 40 acres of mature foraging habitats to forested travel/other habitats. The recently completed Lucky Logger Timber Salvage Permit converted 33 acres of denning habitat and 26 acres of forested travel/other habitats to temporary non-lynx habitats. Proposed DNRC precommercial thinning units would convert 93 acres of forested travel/other habitats to temporary non-lynx habitats, while activities on another 88 acres of temporary non-lynx habitats would not alter the current level of temporary non-lynx habitats. Other SVGBCA cooperators (USFS and Plum Creek) have considerable acreage in the Porcupine Woodward Grizzly Bear Subunit used for the cumulative-effects analysis area (*TABLE W-1-PORCUPINE WOODWARD OWNERSHIP*). Based on interpretation of

TABLE W-6 – LYNX HABITATS. Existing acres and proportions of lynx habitat elements on DNRC-managed lands in the project area and cumulative-effects analysis area.

LYNX HABITAT ELEMENT	PROJECT AREA		CUMULATIVE EFFECTS ANALYSIS AREA	
	ACRES	PERCENT OF LYNX HABITATS	ACRES	PERCENT OF LYNX HABITATS
Denning	934	15.5	1,631	16.5
Mature foraging	2,022	33.4	2,941	29.8
Forested travel/other	2,906	48.1	4,817	48.8
Young foraging	0	0	0	0
Temporary nonhabitat	182	3.0	478	4.8
Grand Total-Lynx Habitats	*6,044*	*100*	*9,863*	*100*
Permanently unsuitable	250		2,373	
Total Acres	*6,294*		*12,263*	

aerial photographs for this larger area, approximately 19,383 acres (or 76 percent of the 25,365 acres of non-DNRC-managed lands) in the 37,614-acre subunit (all ownerships) provide forested habitats with greater than 40 percent canopy closure, providing stand conditions that could support lynx habitat. The remaining 4,075 acres are comprised of younger stands, sparsely vegetated stands, and natural openings. A portion of these younger stands and natural openings likely provide some level of foraging habitat for lynx. Connectivity at the cumulative-effects analysis level is fairly intact but has been diminished in places by past harvesting and road construction.

Specific lynx use of the cumulative-effects analysis area is unknown. However, modeling indicates that lynx habitat is available in adequate proportions, but no lynx tracks have been documented in the vicinity (*M. Parker, Northwest Connections, personal communication, April 17. 2008;* T. Their, DFWP, *personal communication, June 2, 2008*). This evidence indicates that lynx use is not prevalent; however, lynx could be using, or at least traveling through on occasion, portions of the cumulative-effects analysis area.

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Canada Lynx***

In the short term, no changes in lynx habitat elements would be expected in the project area. In the longer term, barring major natural disturbance, natural succession would advance several classes forward, generally improving several classes of lynx habitats; however, the net reduction in young foraging habitats would be expected in the absence of new regenerating stands to replace the stands succeeding out of young foraging habitat. When this occurs, habitat quality for snowshoe hares could decline, thereby reducing the availability of prey for lynx. Mature foraging and denning habitats would be expected to remain at similar levels or increase in the future as shade-tolerant trees develop in the understory and coarse woody debris accumulates through time due to natural events. Forested travel/other habitats would be expected to increase in the future as temporary non-lynx habitats (182 acres) and young foraging habitats mature into this habitat element. Therefore, in the short term, no effects to lynx would be expected. In the longer term, without disturbance, young foraging opportunities in the project area would decrease. Landscape connectivity would not be altered in the near term and may improve in the long-term. Thus, minor beneficial direct and indirect effects to lynx habitats would be expected to occur in the project area for 10 to 20 years since:

1) adequate denning habitats would persist;
2) sufficient mature foraging habitat would exist;
3) young foraging habitats would continue to develop in the next 10 to 20 years within the project area;
4) longer term availability of young foraging habitats would likely decline without disturbance;
5) limited amounts of lynx habitats

would be in the temporary non-lynx habitat category, meaning most of the lynx habitats would be in a usable state for lynx; and

6) landscape connectivity would not be altered.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Canada Lynx***

Each alternative would alter lynx habitat in the project area. In units that would receive seedtree and shelterwood prescriptions, canopy cover and horizontal cover would be removed to prepare for regenerating trees. These prescriptions would convert available lynx habitat elements into temporary non-lynx habitats. Conversely, units proposed to receive variable thin treatments would retain greater than 40-percent canopy cover, thereby converting any specific lynx habitat element into the forested travel/ other category (*TABLE W-7 – CHANGES IN LYNX HABITATS*). No changes to lynx habitats would be anticipated with the proposed gravel pit development since the proposed location was not identified as lynx habitats. While maintaining a suitable mix of lynx habitats (*TABLE W-7 – CHANGES IN LYNX HABITATS*), a range of approximately 1,053 to 1,406 acres of lynx habitats under the action alternatives would be converted to temporary non-lynx habitats. The greatest increase is associated with Action Alternative C and the smallest with Action Alternative D had the smallest increase . Denning habitat would be reduced by 288 to 600 acres, with the greatest reductions associated with Action Alternative C and the smallest reduction being associated with Action Alternative D. Foraging habitats would be reduced by 507 to 556 acres, with the greatest reductions associated with Action Alternatives B and D and the smallest reduction being associated with Action Alternative C (*TABLE W-8 - PROJECT AREA LYNX HABITAT CHANGES*). Continued maturation of younger-aged stands in the project area would gradually move

TABLE W-7 – CHANGES IN LYNX HABITATS. Acreage changes in lynx habitat elements following implementation of the alternatives considered.

CHANGES TO LYNX HABITATS	ALTERNATIVES			
	A	B	C	D
Denning habitat converted to temporary non-lynx habitat	0	401	600	288
Mature foraging habitat converted to temporary non-lynx habitat	0	430	461	454
Other habitat converted to temporary non-lynx habitat	0	404	345	311
Total increase in temporary non-lynx habitat	*0*	*1,235*	*1,406*	*1,053*
Denning habitat converted to other habitat	0	0	0	0
Mature foraging habitat converted to other habitat	0	126	46	102
Other habitat treated but remaining as other habitat	0	159	114	33
Total other habitat resulting from treatments	*0*	*285*	*160*	*135*
Total lynx habitat affected [a]	*0*	*1,520*	*1,565*	*1,187*

[a]*Minor variance from overall project acreages attributed to rounding differences.*

these stands away from the young foraging class and into other classes of lynx habitats. However, the younger-aged stands created by even-aged harvest treatments that are a component of all the action alternatives would provide young foraging habitats further into the future as tree seedlings and shrubs recover and begin providing habitats for snowshoe hares. It could take up to 10 years for seedlings to provide snowshoe hare habitats, and then these ephemeral habitats would gradually outgrow usefulness to snowshoe hares in 10 to 20 years. In all proposed units, 15 to 20 tons of coarse woody debris would be retained to provide some horizontal cover and security structure for lynx. In the short term, lynx would likely avoid proposed harvest units that would be converted to temporary non-lynx habitat, resulting in habitat usage shifts away from the regeneration units. Use of the proposed variable thin units would be expected to continue at some level. Forest connectivity around the openings created with these alternatives would be largely maintained through riparian buffers and other forested habitats in the project area not altered, but overall connectivity would be reduced to varying levels depending upon alternative (see *CONNECTIVITY* in this analysis). Given that the greatest level of denning habitat reduced, the highest amount of foraging habitat removed, the most acres of lynx habitats converted to temporary non-lynx habitats, and the largest effect on landscape connectivity would be expected under Action Alternative C, proportionally more effects to Canada lynx would be anticipated under this alternative. Conversely, Action Alternative D would have the smallest reduction in lynx denning habitat,

***TABLE W-8 - PROJECT AREA LYNX HABITAT CHANGES**. Acres and proportions of lynx habitat elements on DNRC-managed lands in the project area following implementation of each alternative.*

LYNX HABITAT ELEMENT	ACRES OF LYNX HABITAT (PERCENT OF LYNX HABITAT) ELEMENTS FOLLOWING EACH ALTERNATIVE			
	A	**B**	**C**	**D**
Denning	934 (15.5)	533 (8.8)	334 (5.5)	646 (10.7)
Mature foraging	2,022 (33.4)	1,466 (24.3)	1,515 (25.1)	1,466 (24.3)
Other	2,906 (48.1)	2,628 (43.5)	2,607 (43.1)	2,697 (44.6)
Temporary nonhabitat	182 (3.0)	1,417 (23.4)	1,588 (26.3)	1,235 (20.4)
Young foraging	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total acres lynx habitat	*6,044*	*6,044*	*6,044*	*6,044*

intermediate amounts of foraging habitat reductions, the least amount of conversion to temporary non-lynx habitats, and the smallest reduction in landscape connectivity, and thus, proportionally fewer effects to Canada lynx would be anticipated of all the action alternatives. Collectively, minor adverse direct and indirect effects to lynx habitats would be expected to affect Canada lynx in the project area for 20 to 50 years since:

1) adequate denning habitats would persist under all alternatives;
2) sufficient mature foraging would exist under all alternatives;
3) young foraging habitats would continue developing in the next 20 to 50 years in the project area;
4) limited amounts of lynx habitats would be in the temporary non-lynx habitat category meaning most of the lynx habitats would be in a usable state for lynx; and
5) moderate levels of landscape connectivity would persist despite overall reductions in landscape connectivity.

- ***Cumulative Effects of No-Action Alternative A to Canada Lynx***

No appreciable change in lynx habitats would occur under this alternative except the continued maturation of stands. Within the cumulative-effects analysis area, DNRC's ongoing Winter Blowdown Salvage Project would be expected to continue affecting up to 32 acres of lynx habitats, which are mostly forested travel/other habitats. Meanwhile activities associated with the Low Wood Salvage 2 Project would continue converting 40 acres of mature foraging habitats to forested travel/ other habitats. Proposed DNRC precommercial thinning units would convert 93 acres of forested travel/other habitats to temporary non-lynx habitats, while activities on another 88 acres of temporary non-lynx habitats would not alter the current level of temporary non-lynx habitats. The recently completed Lucky Logger Sanitation converted 33 acres of denning habitat and 26 acres of forested travel/other habitats to temporary non-lynx habitats. No projects are proposed for USFS-managed lands that would alter lynx habitats. Some modifications of lynx habitats would be possible with any timber management that may occur on Plum Creek lands. Across all ownerships, continued stand maturation, in the absence of other disturbance, would move temporary non-lynx habitat towards young foraging habitat or forested travel/other habitat. This likely includes a portion of the 4,075 acres of younger stands identified on USFS and Plum Creek lands. A slight increase in young foraging habitats in the cumulative-effects analysis area would be possible in the near term as stands that were harvested in the last 10 to 15 years regenerate tall, dense saplings. Since the amount of developing young foraging habitat would be expected to exceed the amount of young foraging habitat that would mature into forested travel/other habitat, snowshoe hare prey availability would be expected to increase within the next 10 to 20 years.

However, after this time period, young foraging habitat would be expected to decline due to the limited availability of younger-aged regenerating stands to replace the stands transitioning out of young foraging habitats. Gradually, however, as these young foraging stands continue maturing out of the young foraging category and into forested travel/other habitats, habitat quality for snowshoe hares could decline, thereby reducing the availability of prey for lynx in the long term.

Mature foraging and denning habitats would be expected to increase in the future as shade-tolerant trees develop in the understory, coarse woody debris accumulates through time due to natural events, and, in general, stands continue maturing out of young foraging and forested travel/other habitats, which includes a portion of the 19,383 acres in forested stands on USFS, Plum Creek, and other agency/ private lands (*TABLE W-1 - PORCUPINE WOODWARD OWNERSHIP*). Therefore, in the short term, negligible negative effects to lynx would be expected. In the longer term, without disturbance, young foraging opportunities could decrease as stands mature towards mature foraging, denning, and forested travel/other habitats. The no-action alternative would be expected to result in a low risk of reducing the ability of a lynx to survive and reproduce in the area in the short term (10 to 20 years), but could contribute to a decline in young foraging opportunities in 20 to 40 years. Changes to landscape connectivity would be possible with potential harvesting occurring on Plum Creek lands in the cumulative-effects analysis area, however, landscape connectivity would not be further altered within the cumulative-effects analysis area; by DNRC under this alternative. Thus, minor beneficial cumulative effects to lynx habitats would be expected to affect Canada lynx in the cumulative-effects analysis area for 20 to 40 years, since:

1) adequate denning habitats would persist;
2) sufficient mature foraging habitats would exist;
3) young foraging habitats would continue developing in the near term across the cumulative-effects analysis area;
4) longer term availability of young foraging habitats would likely decline without disturbance;
5) limited amounts of lynx habitats would exist in the temporary non-lynx habitat category meaning most of the lynx habitats would be in a usable state for lynx; and
6) landscape connectivity would persist.

- ***Cumulative Effects to Canada lynx Common to Action Alternatives B, C, and D***

Each alternative alters the amounts and proportions of lynx habitat elements in the cumulative-effects analysis area. Denning habitat would be reduced on 288 to 600 acres, with the greatest reduction associated with Action Alternative C and the smallest reduction being associated with Action Alternative D (*TABLE W-7 –CHANGES*

IN LYNX HABITATS); however, following implementation of any alternative, enough lynx denning habitat would be retained on DNRC-managed lands to satisfy DNRC's commitment (*ARM 36.11.435*) of retaining 5 percent lynx habitat in the denning-habitat element (*TABLE W-9 - LYNX HABITATS - CUMMULATIVE-EFFECTS ANALYSIS AREA*). Anticipated reductions in denning habitats would be additive to past losses from timber harvesting, including the recently completed Lucky Logger Sanitation Project, and any ongoing modifications within the cumulative-effects analysis area. No other DNRC concurrent or foreseeable future projects are expected to alter lynx denning habitat in the cumulative-effects analysis area. In addition to denning habitat on DNRC-managed lands, denning habitat is likely to occur within some similar, but unknown proportions of the 19,383 acres of forested, non-DNRC-managed lands in the cumulative-effects analysis area, thereby adding to the amount of denning habitat available. No projects are proposed for USFS-managed lands that would alter lynx denning habitats. Some modifications of lynx habitats are possible with any timber management that may occur on the portion of the 19,383 acres of forested lands in the cumulative-effects analysis area that occur on Plum Creek lands in the cumulative-effects analysis area. Public firewood harvesting could reduce denning structure primarily along open roads. Implementation of any of these alternatives presents a low risk to denning habitat at the level of the cumulative-effects analysis area.

All alternatives would reduce the amount of mature foraging habitats by 507 to 556 acres and would not affect young foraging habitats, with the greatest reductions associated with Action Alternatives B and D, and the smallest reduction being associated with Action Alternative C (*TABLE W-7 – CHANGES IN LYNX HABITATS*). Following the implementation of any alternative, adequate foraging habitats would exist (*TABLE W-9 - LYNX HABITATS - CUMMULATIVE-EFFECTS ANALYSIS AREA*) to meet DNRC's commitment of retaining 10

TABLE W-9 - LYNX HABITATS – CUMMULATIVE-EFFECTS ANALYSIS AREA. Acres and proportions of lynx habitat elements on DNRC-managed lands in the cumulative-effects analysis area following implementation of each alternative.

LYNX HABITAT ELEMENT	ACRES OF LYNX HABITAT (PERCENT OF LYNX HABITAT) ELEMENTS FOLLOWING EACH ALTERNATIVE			
	A	B	C	D
Denning	1,631 (16.5)	1,230 (12.5)	1,031 (10.5)	1,343 (13.6)
Mature foraging	2,941 (29.8)	2,385 (24.2)	2,434 (24.7)	2,385 (24.2)
Other	4,817 (48.8)	4,539 (46.0)	4,518 (45.8)	4,608 (46.7)
Temporary nonhabitat	478 (4.8)	1,713 (17.4)	1,884 (19.1)	1,531 (15.5)
Young foraging	0 (0)	0 (0)	0 (0)	0 (0)
Total acres lynx habitat	*9,863*	*9,863*	*9,863*	*9,863*

percent lynx habitat in mature foraging or young foraging habitats as required under *ARM 36.11.435*. Anticipated reductions in mature foraging habitats would be additive to past losses from timber harvesting and any ongoing modifications in the cumulative-effects analysis area. In addition to foraging habitat on DNRC-managed lands, foraging habitat is likely to occur on some portion of the 19,383 acres with greater than 40-percent canopy cover and the 4,075 acres of younger forest (assuming they have adequate horizontal cover) of adjacent USFS and Plum Creek lands. Activities associated with the DNRC Low Wood Sanitation Project would continue converting 40 acres of mature foraging habitats to forested travel/other habitats. No projects are proposed for USFS-managed lands that would alter lynx foraging habitats. Some modifications of lynx foraging habitats are possible with timber management that may occur on Plum Creek lands in the cumulative-effects analysis area. In 10 to 20 years, any acres converted to temporary non-lynx habitats with this project, as well as any conversions on other ownership, would be expected to regenerate into young foraging habitats, which would result in an increase in foraging habitats available in the cumulative-effects analysis area. Therefore, all alternatives would result in a low risk of reducing foraging opportunities in the cumulative-effects analysis area to the point where a lynx could not successfully inhabit the area. In the longer term, this alternative could result in a minor beneficial effect by increasing foraging habitat for 10 to 30 years.

In the short term, 1,053 to 1,406 acres of available lynx habitats would be converted into temporary non-lynx habitat on DNRC-managed lands in the cumulative-effects analysis area, with the greatest increase being associated with Action Alternative C and the smallest increase associated with Action Alternative D (*TABLE W-7 - CHANGES IN LYNX HABITATS*). These anticipated increases in temporary non-lynx habitats would be additive to past losses of lynx habitats due to timber harvesting, as well as any ongoing modifications within the cumulative-effects analysis area. DNRC's ongoing Winter Blowdown Salvage Project would be expected to continue affecting up to 32 acres of lynx habitats, which are mostly forested travel/other habitats being converted to temporary non-lynx habitats. The proposed DNRC precommercial thinning units would convert 93 acres of forested travel/other habitats to temporary non-lynx habitats, while activities on another 88 acres of temporary non-lynx habitats would not alter the current level of temporary non-lynx habitats. The recently completed Lucky Logger Timber Salvage Project created an additional 59 acres of temporary non-lynx habitats during the winter of 2006/2007. No projects are proposed for USFS-managed lands that would convert any additional lynx habitats to temporary non-lynx habitats. Some modifications of lynx habitats are possible with timber management that may occur on

Plum Creek lands in the cumulative-effects analysis area, likely creating additional temporary non-lynx habitats. Collectively, as these stands regenerate young trees in 10 to 20 years, young foraging habitats would be expected to develop, which would provide habitat for snowshoe hares, which are lynx prey species. Regenerating stands provide high-quality snowshoe hare habitat until the branches of the trees no longer provide horizontal cover at the ground or snow level, which is expected to occur in 10 to 30 years following the successful regeneration of young trees. If these regenerating stands were precommercially thinned prior to this point or if regeneration was poor, these stands may not meet these habitat needs. In either case, the amount of temporary non-lynx habitats would decrease. Some portion of the existing 478 acres (4.8 percent) of temporary non-lynx habitat would likely convert to young foraging or forested travel/ other habitats in the near future (5 to 15 years), thereby offsetting some of the loss of habitat under these alternatives to a degree. Regardless of the conversion of existing temporary non-lynx habitat to usable habitat, each alternative, in combination with other activities in the cumulative-effects analysis area, would be expected to retain enough usable habitats for lynx to successfully inhabit the cumulative-effects analysis area. Therefore, a low risk of preventing lynx use of the cumulative effects analysis area would occur under any action alternative.

In conclusion, all action alternatives would alter 1,187 to 1,565 acres of lynx habitats, with the greatest modifications occurring with Action Alternative C, and the smallest amount of modifications associated with Action Alternative D. However, adequate amounts of denning and foraging habitats would be retained. In 10 to 20 years, each action alternative could result in increased young foraging habitat that could provide increased snowshoe prey availability for an additional 10 to 30 years. Therefore, all action alternatives would be expected to result in a low risk of reducing the ability of a lynx to survive and reproduce in the area in the short term (10 to 20 years) and could benefit lynx in 10 to 20 years by increasing foraging habitat as the harvested stands regenerate and provide snowshoe hare habitat. Landscape connectivity would be further reduced to varying degrees with all alternatives (see *CONNECTIVITY* in this analysis), but moderate levels of landscape connectivity would persist that would facilitate lynx movements. Collectively, Action Alternative C would remove the greatest amount of lynx habitats while moving the most amounts of lynx habitats into the temporary unsuitable category. Action Alternative D would reduce the least amount of lynx habitats and move the fewest acres into the temporary unsuitable category, and, therefore, would likely have slightly lower effects to Canada lynx than Action Alternatives B and C. Thus, minor adverse cumulative effects to lynx habitats would be expected to affect

Canada lynx in the cumulative-effects analysis area for 20 to 50 years since:

1) adequate denning habitats would persist under all alternatives;
2) sufficient mature foraging habitats would exist under all alternatives;
3) young foraging habitats would continue developing for the next 20 to 50 years across the cumulative-effects analysis area;
4) limited amounts of lynx habitats would be in the temporary non-lynx habitat category (less than 20 percent), meaning that most of the lynx habitats would be in a usable state for lynx; and
5) reductions in landscape connectivity would not prevent lynx movements.

- **Gray Wolf**

Issues

Prey availability

The proposed activities could result in reduced habitat quality on winter range for white-tailed deer and elk, which could lead to reduced prey availability and reduce the potential for the area to support a wolf pack.

Disturbance at den and rendezvous sites

The proposed activities could result in disturbance of wolves at denning or rendezvous sites, which could lead to pup abandonment and/or increased risk of mortality.

Disturbance and wolf-human conflicts

The proposed activities could result in increased human disturbance and the potential for wolf-human conflicts that could alter wolf use of suitable habitats.

Introduction

The gray wolf was listed as "endangered" under the *Endangered Species Act* in the northern portion of Montana, which includes the project area. To meet the delisting criteria, the 3 recovery areas need to support a minimum of 30 breeding pairs for 3 consecutive years. The 3 recovery zones have met the recovery objectives for breeding pairs since 2000. In 2007, 107 packs that met the definition of a "breeding pair" were documented within the tri-state region (*USFWS et al. 2008*). Of those 107 packs, 73 occurred in Montana, with 23 of those found in the northern Montana portion of the recovery area, along with 13 additional packs that did not meet the requirements to be considered a "breeding pair" (*Sime et al. 2007*). USFWS delisted gray wolves on March 28, 2008; but a preliminary injunction immediately reinstating protection under the Endangered Species Act was put forth on July 18, 2008. Wolves were listed when the analysis began and pending lawsuits could again change their status. Therefore, wolves will be considered listed as "endangered" for this analysis and any legal protection and conservation measures would be retained with this proposal.

Wolves are a wide-ranging, mobile species. Adequate habitat for wolves consists of areas with adequate prey and minimal human disturbance, especially at den and/or rendezvous sites. The Squeezer Wolf Pack was identified in 2006 and has been monitored by DFWP. While most of the pack locations have occurred in several drainages to the south of the project area, the pack seems to have spent more time in the vicinity of the project area recently and may be denning in the general vicinity (*USFWS et al. 2008, K. Laudon, DFWP, personal communication, April 14, 2008*).

The Northern Rocky Mountain Wolf Recovery Plan (*USFWS 1987*) identified the key components of wolf habitat as:

1) a sufficient, year-round prey base of ungulates (big game) and alternate prey;
2) suitable and somewhat secluded denning and rendezvous sites; and
3) sufficient space with minimal exposure to humans.

Prey availability

Wolves are opportunistic carnivores that frequently take vulnerable prey (including young individuals, older individuals, and individuals in poor condition). In general, wolf densities are positively correlated to prey densities (*Oakleaf et al. 2006, Fuller et al. 1992*). Wolves prey primarily on white-tailed deer and, to a lesser extent, elk and moose, in northwest Montana (*Kunkel et al. 1999*). However, some studies have shown that wolves may prey upon elk more frequently during certain portions of the year (particularly winter) or in areas where elk numbers are higher (*Arjo et al. 2002, Kunkel et al. 2004, Garrott et al. 2006*). Thus, reductions in big game populations and/or winter range productivity could indirectly be detrimental to wolf populations.

Disturbance at den and rendezvous sites

Wolves typically den during late April in areas with gentle terrain near a water source (valley bottoms), close to meadows or other openings, and near big game wintering areas. When the pups are 8 to 10 weeks old, wolves leave the den site and start to leave their pups at rendezvous sites while hunting. These sites are used throughout the summer and into the fall. When the pups are 5 to 6 months old, they start traveling with the pack (*DFWP 2003a*). Disturbance at den or rendezvous sites could result in avoidance of these areas by the adults or force the adults to move the pups to a less adequate site. In both situations, the risk of pup mortality increases.

Disturbance and wolf-human conflicts

One of the primary risks to gray wolves in northwestern Montana is human-wolf conflicts, including control actions to resolve conflicts with livestock, legal and illegal killings, and car/train collisions (*DFWP 2003a*). Besides disturbance at den and rendezvous sites, disturbance can disrupt wolves and/or their big game prey species, emphasizing the need for areas with lower human disturbance. Therefore, activities that lead to increased human presence in wolf habitats could alter wolf use of suitable habitats and reduce overall habitat quality.

Analysis Area

Direct and indirect effects were analyzed for activities conducted in the project area. Cumulative effects were analyzed on the Porcupine Woodward Grizzly Bear Subunit. This cumulative-effects analysis area approximates the amount of area that a wolf pack may use during the summer months while raising their pups (*Mech 1987, Ream et al. 1988*). Outside the denning and rearing period, the pups travel with the pack and home ranges can expand greatly (*DFWP 2003a, USFWS et* *al. 2008*). More information regarding the Porcupine Woodward Grizzly Bear Subunit can be found under *GRIZZLY BEAR* in this analysis.

Analysis Methods

Prey availability

Since changes in winter range could have a sizable effect on the availability of prey for wolves, this section is tied to the *BIG GAME WINTER RANGE* section. Direct and indirect, as well as cumulative effects, were analyzed using field evaluations, aerial photograph interpretation, and a GIS analysis of habitat components. Factors considered in the analysis include the amount of winter range removed, amount of mature forested habitats retained on the winter range, and level of human disturbance. More specifics can be found under *BIG GAME* in this analysis.

Disturbance at den and rendezvous sites

Direct, indirect, and cumulative effects were determined qualitatively following a review of known den and rendezvous sites in the cumulative-effects analysis area. Since these sites are important during certain portions of the year, timing of proposed activities in relation to these sites is also important. Factors considered include the timing and proximity of any activities in relation to any known den or rendezvous sites.

Disturbance and wolf-human conflicts

Open-road density and hiding cover analyses from the *GRIZZLY BEAR* section provide the basis for this section since open roads facilitate human access, which can lead to disturbance of wolves and/or wolf-human conflicts. The hiding-cover component analyzed for grizzly bears was considered a relevant and reasonable parameter for evaluating human-conflict risk in Swan Valley for gray wolves as well. Factors considered in the analysis include the amount of hiding cover available and open-road densities (and associated human disturbance). More specifics can be found in under *GRIZZLY BEAR* in this analysis.

Existing Environment

Prey availability

Big game species are abundant in the project area and the cumulative-effects analysis area. However, big game winter range is somewhat limited (110 acres) within the project area (see *WINTER RANGE* under *BIG GAME*). In the cumulative-effects analysis area, 3,606 acres of big game winter range exist (see *WINTER RANGE* under *BIG GAME*), as well as numerous meadows and other openings near water. Past harvesting on all ownerships in the subunit altered big game and wolf habitats; however, these activities have likely had negligible effects to wolves or their prey. Appreciable amounts of mature, forested habitats exist in the winter range. Low to moderate levels of human disturbance in winter likely affect big game on the winter range. DNRC's Low Wood Sanitation Project could disturb individual deer on the winter range, but minimal change to winter range attributes would be anticipated given the mortality that is occurring or has occurred in the trees being salvaged. No USFS projects are proposed in the cumulative-effects analysis area that would alter big game winter range. Plum Creek has lands in the subunit and winter range, and any harvesting that may occur on their lands could alter big game winter range; however, no specific plans exist, so this will only be included qualitatively. Additionally, the proposed development near Metcalf Lake on private lands could increase disturbance levels in a portion of the big game winter range, which could affect wolf prey species.

Disturbance at den and rendezvous sites

Landscape features commonly associated with denning and rendezvous sites occur in the project area and cumulative-effects analysis area. Although no den or rendezvous sites are known to exist in the project area or cumulative-effects analysis area, 2 areas with centralized locations during the denning period may indicate the presence of a den (*K. Laudon, DFWP, personal communication, April 14, 2008*); the first is in the project area, while the second is in the cumulative-effects analysis area. Ongoing salvage/sanitation associated with DNRC's Low Wood Sanitation and Winter Blowdown Salvage projects could disturb wolf den and/or rendezvous sites; however, mitigations were incorporated into those projects that would limit disturbance at these important habitat features during the seasons of use. No USFS projects are proposed in the cumulative-effects analysis area that would affect wolves at den or rendezvous sites. Plum Creek has lands in the subunit, and any harvesting that may occur on their lands could affect wolves at den and/or rendezvous sites; however, no specific plans exist, so this will only be included qualitatively. Additionally, the proposed development near Metcalf Lake on private lands could increase the potential disturbance at den and/or rendezvous sites with the increased human presence in the area.

Disturbance and wolf-human conflicts

Likely disturbance and human-wolf activities that could create conflicts away from den and rendezvous sites in the project area and cumulative-effects analysis area are largely limited to timber harvesting, general recreation, and any potential for conflicts with human developments on private property. Human activity, generally in the form of dispersed and locally concentrated recreation, ranges from high along Swan River to low along the high elevations of the Mission Divide. Some open roads exist in the project area and cumulative-effects analysis area; as reported in the *GRIZZLY BEAR* section, 30.7 percent of the cumulative-effects analysis area exceeds an open-road density of 1 mile per square mile. In addition, 218.8 miles of restricted roads occur within the cumulative-effects analysis area, which provides nonmotorized access. Hiding cover is abundant in the project area (5,728 acres, 91 percent) and cumulative-effects analysis area (9,785 acres, 80 percent). DNRC's Low Wood 2 and Winter Blowdown salvage projects could disturb wolves. No USFS projects are proposed in the cumulative-effects analysis area that would disturb wolves or increase the potential for human-wolf conflicts. Plum Creek has lands in the subunit, and any harvesting that may occur on their lands could disturb wolves; however, no specific plans exist, so this will only be included qualitatively. Additionally, the proposed development near Metcalf Lake on private lands could increase the potential for wolf-human conflicts and pet-wolf conflicts.

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Gray Wolves***

Prey availability

No changes in white-tailed deer habitat would be expected during the short term; therefore, no changes in wolf prey would be anticipated. Continued use of the project area by wolf prey species would be anticipated. Thus, no direct and indirect effects to wolf prey availability in the project area would be anticipated since:

1) no winter range would be harvested;
2) existing mature, forested stands providing thermal cover and snow intercept would persist;
3) no subsequent changes in abundance of wolf prey would be anticipated; and
4) human disturbance levels would not change.

Disturbance at den and rendezvous sites

No activities would be conducted that could disturb wolves at potential den or rendezvous sites; therefore, no changes to the levels of disturbance to gray wolves at den or rendezvous sites would be anticipated. Wolf use of the project area for denning or rendezvous sites would be expected to continue at current levels. Thus, no direct and indirect effects to gray wolf denning or rendezvous sites in the project area would be anticipated.

Disturbance and wolf-human conflicts

No changes in wolf disturbance levels, open-road densities, available hiding cover, or the potential for wolf-human conflicts would be anticipated that could alter use of the project area, and wolf use of the project area would be expected to continue at current levels. Thus, no direct or indirect effects associated with wolf disturbance and wolf-human conflicts in the project area would be anticipated.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Gray Wolves***

Prey availability

No appreciable change to big game winter range would be anticipated given the limited amounts of identified winter range in the project area (110 acres) and minimal changes to winter range anticipated from the 22-acre gravel pit development associated with all action alternatives. Big game winter range does not exist in any of the proposed units; however, some minor changes in wolf and prey species use of nonwinter habitats would be anticipated across 1,187 to 1,565 acres proposed for harvesting, depending upon alternative, with proportionally greater effects anticipated with Action Alternatives B and C than Action Alternative D. However, no habitat-related changes in overall big game numbers would be expected, and continued use of the project area by these prey species would be anticipated. No changes to human disturbance levels on the winter range would occur unless some activities were conducted during the winter months where truck traffic on open roads could disturb big game on the winter range. Thus, negligible adverse direct and indirect effects to wolf prey availability would be anticipated that would affect wolves in the project area for 10 to 20 years since:

1) minor amounts of winter range would be semi-permanently lost due to the 22-acre gravel pit development;
2) most of the existing mature, forested stands providing thermal cover and snow intercept would persist;
3) no changes to wolf prey numbers would be anticipated; and
4) human disturbance levels could elevate slightly during project activities.

Disturbance at den and rendezvous sites

Proposed harvesting and gravel pit development associated with all alternatives could disrupt wolves at den or rendezvous sites. If a wolf den were confirmed, DNRC would temporarily suspend all mechanized activities and administrative uses over which DNRC has control in areas that are within a 1-mile radius of the den until such time as wolves are known to have vacated the site or the determination has been made that the resumption of activities would not present conflicts with wolf use (*ARM 36.11.430(1)(a)(i)*).

Harvesting activities proposed in the linkage zone, as identified in the SVGBCA (see *GRIZZLY BEAR*), could only occur outside of the spring period (April 1 through June 15) due to SVGBCA stipulations, thereby further limiting the risk of disturbance to wolves at den sites should they occur in that area. However, the potential den sites occur outside of the linkage zone that affords this level of seasonal protection. In these spring closure areas, when harvesting becomes active in mid-June, wolves would likely have moved their pups to rendezvous sites, where human disturbance could also be harmful. If a rendezvous site were located, DNRC would temporarily suspend operations within 0.5 mile of the site until the determination is made that resumption of activities will not present conflicts with wolf use (*ARM 36.11.430(1)(b)*). Additionally, DFWP plans to continue monitoring this pack and could provide further information should either of these sites be identified. With these mitigations in place, none of the action alternatives would be expected to disrupt wolves at key locations. Thus, since disruptions at den and rendezvous sites would be mitigated, minor adverse direct and indirect effects to disturbance levels at dens and rendezvous sites would be anticipated that would affect wolves in the project area for the duration of the proposed project activities (3 to 5 years).

Disturbance and wolf-human conflicts

Disturbance at den and rendezvous sites should be minimized with included mitigations; however, all alternatives could increase human activities in wolf habitats, thereby increasing the potential for disturbing wolves. Spatially, Action Alternatives B and D would be less concentrated and would likely create the potential for more-widespread disturbance to wolves, while Action Alternative C would be more concentrated and less widespread, and thus, would likely have lower disturbing influence on gray wolves unless wolves shifted their use into the area where activities would be concentrated. The risk of human-wolf conflicts and/or wolf mortality in the project area could be increased through additional human access and reduced hiding cover attributable to new road construction and logging operations. Under all alternatives, a range of 9.5 to 14.0 miles of new, restricted road would be constructed to harvest the proposed units, with the largest increase in permanent, closed road being associated with Action Alternative B and the least amount of permanent, closed-road construction being needed under Action Alternative C (*TABLE W-10 – PROJECT AREA WOLF HABITATS*). All new roads would be managed as restricted, limiting changes in open-road densities, but facilitating increased nonmotorized traffic. Timber harvesting and gravel pit development could remove between 1,235 and 1,734 acres of hiding cover for 10 to 20 years, depending on the alternative, with Action Alternative C having the largest reduction in hiding cover, and Action Alternative D reducing hiding cover the least (*TABLE W-10 – PROJECT AREA WOLF HABITATS*). Following implementation of any alternative, a high proportion of hiding cover (ranging from 63 percent to 71 percent) would still remain in the project area. To mitigate the risks associated with increased human access during logging operations and the reduction of hiding cover, regeneration units would be laid out, so that no point of any unit would be greater than 600 feet to cover, visual screening would be retained between open roads and regeneration units (seedtree and shelterwood), and contractors would not be allowed to carry firearms while on duty. Action Alternative B would affect an intermediate amount of hiding cover in a less-concentrated area and could possibly create a more widespread disturbance while requiring the most

TABLE W-10 – PROJECT AREA WOLF HABITATS. Proposed amounts of hiding cover removed; remaining hiding cover; amount of linear miles of permanent, restricted road construction; and resultant miles of restricted roads expected under each alternative in the project area.

PARAMETER	ALTERNATIVES			
	A	B	C	D
Acres of hiding cover removed	0	1,614	1,734	1,235
Acres of hiding cover retained in the project area after implementation of each alternative (percent reduction)	5,728 (0)	4,070 (28.2)	3,950 (30.3)	4,449 (21.6)
Linear miles of new permanent, restricted road	0	14.0	9.5	11.2
Linear miles of permanent restricted road (percent increase)	35.4 (0)	49.4 (39.5)	44.9 (26.8)	46.6 (31.6)

road construction. Conversely, Action Alternative C would alter the most hiding cover in a concentrated area away from the centers of recent wolf activity and would be expected to have slightly lower effects than Action Alternatives B and D. Thus, minor adverse direct and indirect effects to disturbance levels and wolf-human conflicts would be anticipated that would affect wolves in the project area for the next 10 to 30 years since:

1) no changes in open-road densities would be anticipated;
2) newly constructed roads would be closed to the general public, but could facilitate increased nonmotorized human access;
3) hiding cover would be removed, but considerable hiding cover would be retained; and
4) SVGBCA stipulations would mitigate some of the cover losses/ conflict issues while the Forest Management Rules would reduce disturbance at key sites.

- ***Cumulative Effects of No-Action Alternative A to Gray Wolves***

Prey availability

No changes in prey availability would be anticipated under this alternative. No additional disturbance or displacement would be anticipated within the cumulative-effects analysis area. Minimal changes in white-tailed deer habitats would be expected during the short term; therefore, no changes in wolf prey densities would occur. Continued white-tailed deer use of the winter range and cumulative-effects analysis area during the nonwinter period would be anticipated; no changes in wolf use of the cumulative-effects analysis area would be expected. Thus, no further cumulative effects to wolf prey availability in the cumulative-effects analysis area would be anticipated since:

1) no winter range would be harvested;
2) existing mature, forested stands providing thermal cover and snow intercept would persist;
3) no changes to wolf prey numbers would be anticipated; and
4) human disturbance levels would not change.

Disturbance at den and rendezvous sites

Under this alternative, no activities would be conducted that would affect known den or rendezvous sites during the important use periods, existing ongoing activities are distant from potential denning sites, and mitigations would limit disturbance potential at these sites; thus, no further cumulative effects to gray wolf denning or rendezvous sites in the cumulative-effects analysis area would be anticipated.

Disturbance and wolf-human conflicts

No changes to wolf disturbance levels, open-road densities, or the potential for wolf-human conflicts would be expected with this alternative. Thus, no further cumulative effects to wolf disturbance or wolf-human conflicts in the cumulative-effects analysis area would be anticipated since:

1) no change in disturbance levels or open-road densities would be anticipated;
2) no further changes in available hiding cover would be anticipated; and
3) no increases in the potential for wolf/human conflicts would be anticipated.

- ***Cumulative Effects to Gray Wolves Common to Action Alternatives B, C, and D***

Prey availability

No appreciable change to big game winter range would be anticipated given the limited amounts of winter range in the project area and minimal changes to winter range anticipated under any alternative. Minor changes in nonwinter habitat use would be possible; however, no changes in overall big game numbers would be anticipated. Ongoing salvage/ sanitation associated with the Low Wood Sanitation Project could disturb individual deer on the winter range, but minimal change to winter-range attributes would be anticipated given the mortality that is occurring or has occurred in the trees being salvaged. No activities are proposed on USFS lands that would alter wolf prey availability. Any activities on Plum Creek lands could alter big game habitat use patterns, but would not be expected to appreciably alter prey availability. Collectively, any harvesting during the winter that may occur on Plum Creek lands would be additive to any potential winter harvesting that may occur outside of the winter range with this project, which could contribute to elevated disturbance and/or displacement on the winter range due to the associated hauling through the winter range. Minimal changes in white-tailed deer habitats would be expected during the short term; therefore, no subsequent changes in wolf prey densities would occur. Continued white-tailed deer use of the winter range and cumulative-effects analysis area during the nonwinter period would be anticipated; no changes in wolf use of the cumulative-effects analysis area would be expected. No changes to human disturbance levels in the winter range would occur unless some activities were conducted during the winter, which would be limited to hauling on open roads and/or harvesting and associated hauling from Plum Creek lands within the winter range. Thus, negligible adverse cumulative effects to wolf prey availability would be anticipated that would affect wolves in the cumulative-effects analysis area for 10 to 20 years since:

1) minor amounts of winter range (22 acres) associated with the 22-acre gravel pit would be semipermanently lost;
2) considerable amounts of existing mature, forested stands providing thermal cover and snow intercept would persist;
3) no changes to wolf prey numbers would be anticipated despite slight habitat shifts; and
4) minor changes in human disturbance levels during project activities could occur.

Disturbance at den and rendezvous sites

Proposed units and haul routes exist in a mile of the potential den site that may exist in the project area. Mitigations that would be included with all alternatives would reduce the risk of potential disturbance to wolves at dens and rendezvous sites, should either one be confirmed within the cumulative-effects analysis area. Ongoing DNRC salvage/sanitation projects (see *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER I*) and proposed precommercial thinning activities could disturb wolves at den and rendezvous sites; however, no known den or rendezvous sites are within the cumulative-effects analysis area. The other location with centralized locations during the denning period is outside of the project area, but within the cumulative-effects analysis area; however, neither ongoing nor proposed activities occur in the same vicinity as this potential den site. Similar to mitigations associated with each of these action alternatives, mitigations affording various levels of protection should a wolf den or rendezvous be confirmed in the vicinity of these other activities were included with those other DNRC projects. No activities are proposed on USFS lands that would disturb wolves at dens and rendezvous sites. Plum Creek has lands within the subunit, and any potential harvesting could disturb wolves at dens and rendezvous sites. Action Alternative C would concentrate activities in the northern portion of the cumulative-effects analysis area, which would have proportionally lower effects since the Squeezer Wolf Pack has been spending more time in the southern portion of the cumulative-effects analysis area lately. Meanwhile, Action Alternatives B and D would have a much greater chance of disturbing wolves at den or rendezvous sites since these alternatives have proposed units in the southern portion of the cumulative-effects analysis area where more recent wolf activity has been documented. Thus, negligible cumulative effects to gray wolf denning or rendezvous sites would be anticipated that would affect wolves in the cumulative-effects analysis area for 3 to 5 years since:

1) no activities would be conducted near known den or rendezvous sites during the important use periods; and
2) DNRC employs mitigations to protect these important locations during the seasons of potential use should these locations be identified.

Disturbance and wolf-human conflicts

All alternatives could increase human presence in wolf habitats and increase the risk of wolf-human conflicts by increasing the potential for nonmotorized access and reducing hiding-cover values in the project area. Implementation of any action alternative would reduce the hiding cover by 11.8 to 15.8 percent on DNRC-managed lands in the cumulative-effects analysis area, and by 3.4 to 4.8 percent across all ownerships within the cumulative-effects analysis area for 10 to 20 years, depending on

TABLE W-11 – WOLF HABITAT PARAMETERS – CUMMULATIVE-EFFECTS ANALYSIS AREA. Estimated percentages of hiding cover retained and amounts of linear miles of permanent, restricted road construction that would result following implementation of each alternative.

PARAMETER	ALTERNATIVES			
	A	B	C	D
Percent hiding cover on DNRC-managed lands (percent reduction)	78.2 (0)	65.0 (13.2)	64.1 (14.2)	68.1 (10.1)
Percent hiding cover retained in the Porcupine Woodward Subunit – all cooperators (percent reduction)	79.0 (0)	74.6 (4.5)	74.2 (4.8)	75.6 (3.4)
Linear miles of permanent, restricted road to be improved	0	62.9	41.6	60.4
Linear miles of restricted roads (percent increase)	218.8 (0)	232.8 (6.4)	228.3 (4.3)	230.0 (5.1)

alternative, with the greatest effects expected with Action Alternative C (*TABLE W-11 – WOLF HABITAT PARAMETERS - CUMMULATIVE-EFFECTS ANALYSIS AREA*). These reductions in cover would be additive to losses associated with ongoing DNRC salvage/sanitation projects (see *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER I*), proposed precommercial thinning, past harvesting on all ownerships, and any potential harvesting that may occur on Plum Creek lands. No activities are proposed on USFS lands that would alter wolf hiding cover. Despite these reductions, following implementation of any action alternative, a high proportion of hiding cover (ranging from 64.1 percent to 68.1 percent of DNRC-managed lands; 74.2 percent to 75.6 percent of all ownerships) would still remain in the cumulative-effects analysis area, with the greatest reduction being associated with Action Alternative C, and the smallest reduction being associated with Action Alternative D. Although no threshold levels of hiding cover have been established for wolves, the threshold (i.e., at least 40 percent to be retained in each subunit) developed for grizzly bears (*SVGBCA 1997*) would likely also provide security for wolves.

The presence and maintenance of restricted roads produces a long-term potential for additional disturbance to wolves and increased risk of wolf/ human conflicts when compared to areas without road access. This alternative would increase the linear mileage of restricted roads from 218.8 to between 228.3 and 232.8 miles, a 4.3 to 6.4 percent increase, with the greatest increase anticipated under Action Alternative B, and the smallest increase anticipated under Action Alternative C (*TABLE W-11 – WOLF HABITAT PARAMETERS - CUMMULATIVE-EFFECTS ANALYSIS AREA*). Road use associated with ongoing DNRC salvage/sanitation projects (see *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* in *CHAPTER*

I) and proposed precommercial thinning activities could disturb wolves, but would not alter open-road densities. No further changes in open roads or the potential for wolf-human conflicts would be anticipated on DNRC-managed ownership. No activities are proposed on USFS lands that would alter open roads and human access or increase the likelihood of human-wolf conflict. Any potential activities on Plum Creek lands would not change the open-road status, but could alter hiding cover and increase the potential for nonmotorized traffic, which could lead to increased wolf-human conflicts. Mitigations would be in place to protect key sites on DNRC-managed ownership (*ARM 36.11.430(1)(a)*) and restrictions on carrying firearms while on duty (*SVGBCA 1997*) would apply across all SVGBCA cooperators, reducing the overall risk to wolf mortality in the cumulative-effects analysis area. Action Alternative B, with the more widespread disturbance, greatest level of road construction, and intermediate amounts of hiding cover reductions, would be anticipated to have the greatest chance to disturb wolves. Under Action Alternative C, disturbance would be more concentrated and occur in an area more distant from the areas of concentrated use, but would remove the greatest amount of hiding cover in a smaller area, and, therefore, would be expected to likely have slightly fewer effects than Action Alternatives B and D. Collectively, minor adverse cumulative effects to disturbance levels and wolf-human conflicts would be anticipated that would affect wolves in the cumulative-effects analysis area for the next 10 to 30 years since:

1) no changes in open roads would be anticipated;
2) a moderate amount of hiding cover would be removed; and
3) SVGBCA stipulations would mitigate some of the cover losses/ conflict issues while the Forest Management Rules would reduce disturbance at key sites.

- **Grizzly Bear**

Issues

Hiding cover

A concern was voiced that activities associated with this project could result in a reduction of hiding cover that is important for grizzly bears, which could result in increased displacement of grizzly bears, avoidance of otherwise suitable habitat, and/or increased risk of bear-human conflicts.

Open-road density

A concern was raised that activities associated with this project could result in an increase in the density of roads, which could result in increased displacement of grizzly bears and increased risk of bear-human conflicts.

Security habitat

A concern was expressed that activities associated with this project could result in a decrease in secure areas for grizzly bears, which could result in increased displacement of grizzly bears.

Introduction

Grizzly bears are native generalist omnivores that use a diversity of habitats found in western Montana and are currently listed as "threatened" under the *Endangered Species Act*. Preferred grizzly bear habitats are meadows, riparian zones, avalanche chutes, subalpine forests, and big game winter ranges, all of which provide seasonal food sources. Within the project area, primary habitat components include meadows, riparian areas, and big game winter ranges. Primary threats to grizzly bears are related to human-bear conflicts, habituation to unnatural foods near high-risk areas, and long-term habitat loss associated with human development (*Mace and Waller 1997*). Forest-management activities may affect grizzly bears by altering cover and/or by increasing access to humans into secure areas by creating roads (*Mace et al. 1997*). These actions could lead to the displacement of grizzly bears from preferred areas and/or result in an increased risk of human-caused mortality by bringing humans and bears closer together and/or making bears more detectable, which can increase their risk of being shot illegally. Displacing bears from preferred areas may increase their energetic costs, which may in turn lower their ability to survive and/or reproduce successfully.

In Swan Valley, DNRC, USFS, Plum Creek, and USFWS collaborated to cooperatively manage grizzly bear habitat, linkage, and human access under the SVGBCA (*SVGBCA 1997*). Under this agreement, a rotation of active and inactive subunits was devised. The rotation schedule allows for active subunits where harvesting activities might displace grizzly bears and inactive subunits where commercial activities are prohibited to provide undisturbed habitat. These rotations currently occur on a 3-year-active and 6-year-inactive basis. The Porcupine Woodward Grizzly Bear Subunit is scheduled to become active during the 2009 through 2011 period.

When a subunit is active, harvesting activities would not occur during the spring period (April 1 through June 15) in spring habitat (areas within designated linkage zones below 5,200 feet). After the spring period, harvesting activity and associated road use can occur unrestricted in the active subunit. However, any restricted road used for commercial activities would require restriction of public use through the placement of signs while harvesting activities are occurring, and the placement of a barrier across the road when harvesting activities are not occurring (weekends, nights, inactive periods, etc.). Other stipulations under the SVGBCA include:

- retaining a minimum of 40 percent of each subunit in grizzly bear hiding cover,
- managing open-road densities so that no more than 33 percent of any subunit exceeds an open-road density of 1 mile per square mile,
- tracking total road densities and amounts of secure habitat (i.e., security core),
- retaining of a 100-foot visual buffer between open roads and the even-aged harvest units,
- utilizing uneven-aged management in the riparian zones,
- laying out harvest units so that no point is greater than 600 feet to cover, and

- restricting contractors from carrying firearms while on duty.

Analysis Area

Direct and indirect effects were analyzed for activities conducted in the project area. The Porcupine Woodward Grizzly Bear Subunit was selected as the grizzly bear cumulative-effects analysis area. This area approximates the home range size of a female grizzly bear. Additionally, analyses required by the SVGBCA are reported at the grizzly bear management subunit scale. Considerable amounts of the subunit are managed by DNRC, USFS, and Plum Creek (*TABLE W-1 - PORCUPINE WOODWARD OWNERSHIP*).

Analysis Methods

Hiding cover

To assess hiding cover, DNRC's SLI data were used to map stands that would serve as hiding cover and be consistent with the definition of 'Cover' contained in the SVGBCA. Under the SVGBCA, each subunit must contain "Cover" on a minimum of 40 percent of all lands in the subunit. Factors considered in the analysis include the amount of hiding cover.

Open-road density

A moving-windows analysis (*Ake 1994*) was conducted to determine open-road densities within the Porcupine Woodward Grizzly Bear Subunit. Results included areas that exceeded an open-road density of 1 mile per square mile. Factors considered in the analysis include the amount of the area with open-road densities greater than 1 mile per square mile.

Security habitat

Secure habitats are areas that are free of motorized human access. Specifically, secure habitats need to be greater than 0.3 miles (500 meters) from any open road, restricted road, or high-use roads and trails and meet a minimum size of 2,500 acres. A moving-windows analysis (*Ake 1994*) was conducted to determine areas that provide secure habitats and areas that exceed a total road density of 2 miles per square mile. Open and gated roads were buffered by 1,640 feet (500 meters), and the resultant area was removed from the subunit to obtain the amount of potential secure habitat in the cumulative-effects analysis area.

The presence and maintenance of restricted roads produces a long-term potential for additional disturbance to grizzly bears and increased risk of human-caused mortality when compared to areas without road access. Since even restricted roads pose a risk to grizzly bears, total road-density estimates were used as a surrogate for that amount of the area potentially receiving more motorized and nonmotorized use. Spring habitats in the identified linkage zone receive additional consideration under the SVGBCA in an effort to provide connectivity while creating relatively undisturbed areas in the spring. Factors considered in the analysis include amount of available security habitat, total road densities, and amount of habitats affected in the linkage zone.

Existing Environment

Hiding cover

Past timber harvesting in Swan Valley on all ownerships have resulted in an obvious patchwork comprised of variously-shaped, multiaged forest stands, which exist at differing stages of successional development. Hiding cover exists on 91 percent of the DNRC-managed lands in the project area. Presently, hiding cover in the Porcupine Woodward Grizzly Bear Subunit exists on 80 percent of DNRC-managed lands, 83 percent of USFS-managed lands, and 73 percent of Plum Creek lands, averaging (weighted on acres) 80 percent for the subunit (*SVGBCA Monitoring Team 2007*).

Some of the ongoing and recently completed salvage/sanitation activities have altered hiding cover (Lucky Logger, Low Wood), while others (Winter Blowdown) have not likely altered hiding cover due to the nature of the salvaged material. The proposed precommercial thinning could alter approximately 180 acres of hiding cover in the subunit. No other DNRC projects that would alter grizzly bear hiding cover are proposed in the Porcupine Woodward Grizzly Bear Subunit. Other SVGBCA cooperators (USFS and Plum Creek) have considerable acreage in the Porcupine Woodward Grizzly Bear Subunit used for the cumulative-effects analysis area. No activities are proposed on USFS lands that would alter grizzly bear hiding cover. Any activities that Plum Creek may conduct on their lands in the near future would likely alter grizzly bear hiding cover; however, no specific plans exist, so this will be addressed qualitatively.

Open-road density

Extensive road systems that have been required over the years to facilitate intensive logging are also evident in the valley. These road systems now provide a number of access routes into otherwise remote areas. Presently, 20.5 percent of the project area and 30.7 percent of the Porcupine Woodward Grizzly Bear Subunit have open-road densities greater than 1 mile per square mile of open road.

No other proposed or ongoing DNRC projects that would alter open-road densities are in the Porcupine Woodward Grizzly Bear Subunit. Other SVGBCA cooperators (USFS and Plum Creek) have considerable acreage within the Porcupine Woodward Grizzly Bear Subunit (*TABLE W-1* - *PORCUPINE WOODWARD OWNERSHIP*), which is used for the cumulative-effects analysis area. No activities that would alter open-road densities are proposed on USFS lands. Any activities that Plum Creek may conduct on their lands in the near future could alter total road densities, but would not likely alter open-road densities; however, no specific plans exist, so this will be addressed qualitatively.

Security habitat

Security habitat currently exists on approximately 27.2 percent of the project area and roughly 25.9 percent of the subunit. Although the SVGBCA does not contain standards for security habitats or total-road densities on DNRC-managed and Plum Creek lands, it requires the cooperators to annually report these values by subunit. Approximately 90.5 percent of the project area and 75.0 percent of the cumulative-effects analysis area exceeds 2 miles per square mile of total-road density. Additionally, seasonally secure habitats are provided for grizzly bears by limiting all management activities during the spring period in identified linkage zones below 5,200 feet of elevation. Approximately 3,433 acres (54.5 percent) of the project area exist in the Swan River State Forest Linkage Zone. Past harvesting in the linkage zone has modified roughly 1,606 acres in the last 30 years in this linkage zone.

Ongoing salvage/sanitation projects are not altering security habitats or total road densities, but may be altering cover attributes in spring habitats in linkage zones. No other DNRC projects are proposed within the Porcupine Woodward Grizzly Bear Subunit that would alter grizzly bear security habitats or total road densities; spring habitats in the linkage zone could be altered with the proposed precommercial thinning; however, this would be expected to have minimal effects on grizzly bears moving through the area. Other SVGBCA cooperators (USFS and Plum Creek) have considerable acreage within the Porcupine Woodward Grizzly Bear Subunit (*TABLE W-1 - PORCUPINE WOODWARD OWNERSHIP*). No activities are proposed on USFS lands that would alter grizzly bear security habitats, total road densities, or spring habitats in linkage zones. Any activities that Plum Creek may conduct on their lands in the near future would not affect grizzly security habitats, but could alter total road densities and/or spring habitats in linkage zones (just not during the spring); however, no specific plans exist, so this will be addressed qualitatively.

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A on Grizzly Bears***

Hiding cover

No vegetation modification would occur; therefore, no changes to existing hiding cover would be anticipated. Thus, no direct and indirect effects to grizzly bear hiding cover in the project area would be anticipated.

Open-road density

No changes to the open-road status, open-road densities, or risk of grizzly bear displacement caused by vehicular noise or human access would occur. Thus, no direct and indirect effects to open-road densities or, subsequently, grizzly bears in the project area would be anticipated.

Security habitat

No alteration of habitat attributes or increased human presence would occur. No changes to total road densities or spring grizzly bear habitats in linkage zones would occur. Therefore, no changes in grizzly bear security habitats or human-caused mortality risk in the project area would be expected under this alternative.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Grizzly Bears***

Hiding cover

A range of 1,235 to 1,734 acres of hiding cover would be removed from the 5,728 existing acres with the proposed harvest and gravel pit development in the project area, with the greatest reduction in hiding cover occurring in a concentrated area associated with Action Alternative C, and the smallest reduction occurring across a broad area with Action Alternative D (*TABLE W-12 - PROJECT AREA GRIZZLY BEAR HABITAT PARAMETERS*). Because the DNRC model used to estimate grizzly bear hiding cover incorporates a buffering feature designed to ensure cover patches are large enough to adequately provide cover for bears, in some cases estimates of cover removed for the action alternatives may be larger than actual acreages harvested. This feature of the model helps ensure that small inadequate patches of forest cover that are an artifact of the size and position of logging units are not included in reported estimates. In several instances, this removed patches of cover outside of the proposed units due to the resulting patches of cover that were too narrow to function as cover. To reduce the avoidance of harvest units and provide some security, the seedtree and shelterwood harvest units would be laid out to ensure that no point of the unit exceeds 600 feet to cover, and visual screening would be retained in a 100-foot strip between the harvest units (and gravel pit) and open roads. Collectively, Action Alternative D would be expected to have slightly less effects than Action Alternatives B and C. Thus, the minor adverse direct and indirect effects to hiding cover that

TABLE W-12 – PROJECT AREA GRIZZLY BEAR HABITAT PARAMETERS. Proposed amounts of hiding cover removed; amount of linear miles of permanent, miles of open and restricted road construction; resultant miles of open and restricted roads expected under each alternative; and acres of spring habitats altered in the linkage zone in the project area.

PARAMETER	ALTERNATIVES			
	A	B	C	D
Acres of hiding cover removed	0	1,614	1,734	1,235
Acres of hiding cover retained in the project area after implementation of each alternative (percent reduction)	5,728 (0)	4,070 (28.2)	3,950 (30.3)	4,449 (21.6)
Linear miles of new permanent, restricted road constructed	0	14.0	9.5	11.2
Linear miles of permanent restricted road (percent increase)	35.4 (0)	49.4 (39.5)	44.9 (26.8)	46.6 (31.6)
Miles of new permanent open road constructed	0	0	0	0
Miles of permanent open road (percent increase)	2.4 (0)	2.4 (0)	2.4 (0)	2.4 (0)
Percent of security habitat remaining after implementation of each alternative (percent reduction)	27.2 (0)	8.2 (19.0)	19.3 (7.9)	15.7 (11.5)
Acres of spring habitats in the linkage zone modified (percent of unit acreages occurring in the linkage zone)	0 (0)	944 (62.1)	1,565 (100.0)	860 (72.5)
Acres of spring habitats in the linkage zone within the project area that would not be altered (percent reduction)	3,433 (0)	2,489 (27.5)	1,868 (45.6)	2,573 (25.1)

would affect grizzly bears in the project area for the next 10 to 30 years would be anticipated since:

1) hiding cover would be reduced across a portion of the project area, but considerable hiding cover would remain in the project area (3,950 to 4,449 acres remaining), and
2) SVGBCA mitigations to ensure that no point in a regeneration unit is more than 600 feet to cover and that a minimum of 40 percent of DNRC's-managed lands meet the definitions for hiding cover would provide some cover-related benefits for bears in the project area.

Open-road density

Proposed harvesting activities could result in short-term displacement effects, while the construction of new roads could result in both short- and long-term displacement effects. Under all alternatives, between 9.5 and 14.0 miles of new permanent roads would be constructed, adding to the existing 35.4 miles in the project area, with the greatest amounts constructed under Action Alternative B and the least amount constructed under Action Alternative C (*TABLE W-12 – PROJECT AREA GRIZZLY BEAR HABITAT PARAMETERS*). All newly constructed roads would be managed as restricted, which would not change the amount of open roads or open-road densities (*TABLE W-12 – PROJECT AREA GRIZZLY BEAR HABITAT PARAMETERS*). All newly constructed roads would be behind existing closure devices to allow for administrative and commercial use. Thus, since open-road densities would not change, no direct and indirect effects associated with open-road densities would be anticipated that would affect grizzly bears in the project area for the foreseeable future.

Security habitat

Although, no changes in open roads would be anticipated, reductions in security habitats (ranging between 7.9 percent and 19.0 percent, depending on the alternative) would be anticipated in the project area, with the greatest reduction being associated with Action Alternative B, and the smallest reduction being associated with Action Alternative C (*TABLE W-12 – PROJECT AREA GRIZZLY BEAR HABITAT PARAMETERS)*. Alterations of vegetation in proposed units could make grizzly bears more visible; however, maintaining new and existing roads as restricted and prohibiting contractors from carrying firearms while on duty would minimize risk of human-caused mortality. An increase in total road densities and disturbance levels associated with commercial timber harvesting would be anticipated, with the greatest increase associated with Action Alternative B, and the least amount of construction associated with Action Alternative C (*TABLE W-12 - PROJECT AREA GRIZZLY BEAR HABITAT PARAMETERS*). Harvesting would alter 860 to 1,565 acres of spring habitats in the linkage zone, with Action Alternative C harvesting the most in the linkage zone and Action Alternative D harvesting the least in the linkage zone. The proposed gravel pit would be outside of the linkage zone and would not alter security habitat or total road densities. Action Alternative B, with the greatest reduction in security habitat, most reductions within the linkage zone, and lowest amount of newly constructed roads, coupled with intermediate amounts of hiding cover removed (see *HIDING COVER* under *GRIZZLY BEAR*), would be expected to have proportionally more effects to grizzly bears, while Action Alternative D, with intermediate increases in total road densities, least amount of habitat affected in the linkage zone, and intermediate reductions in security habitat, coupled with the lowest amount of hiding cover removed,

TABLE W-13 – GRIZZLY BEAR HABITAT PARAMETERS – CUMMULATIVE-EFFECTS ANALYSIS AREA. - Anticipated changes to open-road densities, hiding cover, restricted roads, total road densities, security habitats, and spring habitats in the linkage zone under each alternative.

PARAMETER	SVGBCA REQUIREMENTS	ALTERNATIVES			
		A	B	C	D
Percent of the area with an open-road density greater than 1 mile per square mile	No more than 33	30.7	30.7	30.7	30.7
Percent of hiding cover retained on DNRC-managed lands	No less than 40	78.2	65.0	64.1	68.1
Percent of hiding cover anticipated to exist on all ownerships [1]	No less than 40	79.0	74.6	74.2	75.6
Linear miles of restricted roads	No limit	218.8	232.8	228.3	230.0
Percent of the area with a total-road density greater than 2 miles per square mile	No limit	75.0	76.5	75.8	75.8
Percent of security habitat remaining after implementation of each alternative	No limit	25.9	24.1	25.4	24.7
Altered acres of spring habitats in linkage zone	No limit	0	944	1,565	860
Acres of spring habitats in linkage zone that would not be altered on all ownerships (percent reduction)	No limit	12,844 (0)	11,900 (7.3)	11,279 (12.2)	11,984 (6.7)

[1] *Amount of hiding cover for USFS and Plum Creek lands was adapted from the SVGBCA Monitoring Team Report (2007).*

would be expected to have proportionally the least amount of effects to grizzly bears. Collectively, low to moderate adverse direct and indirect effects to grizzly bear security habitats would be anticipated that would affect grizzly bears in the project area for the foreseeable future since:

1) security habitat would be reduced by 7.9 to 19 percent, depending on alternative;
2) total road densities would increase slightly in the project area by 26.8 to 39.5 percent, depending on alternative;
3) increased disturbance caused by commercial harvesting would occur during the nondenning period for 3 years; and
4) spring habitats within the linkage zone would be altered across 860 to 1,565 acres, depending on alternative.

- ***Cumulative Effects of No-Action Alternative A to Grizzly Bears***

Hiding cover

No vegetation modification would occur; therefore, no changes to existing hiding cover would be anticipated *(TABLE W-13 - GRIZZLY BEAR HABITAT PARAMETERS - CUMMULATIVE-EFFECTS ANALYSIS AREA)*. Vegetation within the project area and cumulative effects analysis area that are providing hiding cover would be expected to continue providing this attribute for the foreseeable future. Thus, no further cumulative-effects to hiding cover would be anticipated that would affect grizzly bears in the cumulative effects analysis area until some other form of disturbance reverses stand succession since:

1) no further changes in hiding cover would be expected on DNRC-managed lands under this alternative and
2) considerable amounts of the cumulative-effects analysis area are providing hiding cover.

Open-road density

No changes to open roads or open-road densities would be anticipated. The 30.7 percent of the subunit with an open-road density greater than 1 mile per square mile would be below the 33-percent maximum threshold for open-road densities as established within the SVGBCA. Thus, no further cumulative effects to open-road densities would be anticipated that would affect grizzly bears in the cumulative-effects analysis area for the foreseeable future since:

1) open-road densities would not change and
2) the amount of the subunit with an open-road density greater than 1 mile per square mile would continue to be below the maximum threshold established with under the SVGBCA.

Security habitat

No changes to open roads, grizzly bear security habitats, total road densities, amount of spring habitats altered in the linkage zone, or potential for human-caused mortality would be anticipated. No changes would be anticipated to the 25.9 percent of the cumulative-effects analysis area that is currently providing security habitats. Likewise, the 75.0 percent of the cumulative-effects analysis area exceeding a total road density of 2 miles per square mile would not be expected to change. No further changes to any spring habitats in the linkage zone would occur. Thus, no further cumulative effects would be anticipated to security habitats that would affect grizzly bears in the cumulative effects analysis area for the foreseeable future since:

1) security habitats would not change;
2) appreciable amounts of the subunit would be providing security habitats;
3) total road densities would not change; and
4) spring habitats in the linkage zone would not be affected.

- ***Cumulative Effects to Grizzly Bears Common to Action Alternatives B, C, and D***

Hiding cover

Reductions in hiding cover on 1,235 to 1,734 acres (3.4 to 4.8 percent of the cumulative-effects analysis area) would remain in the project area following implementation of the action alternatives due to the proposed harvesting and gravel pit development, with the greatest reduction being associated with Action Alternative C, and the smallest reduction being associated with Action Alternative D *(TABLE W-13 - GRIZZLY BEAR HABITAT PARAMETERS - CUMMULATIVE-EFFECTS ANALYSIS AREA)*. Vegetation elsewhere in the project area and cumulative-effects analysis area that is providing hiding cover would be expected to continue providing this attribute for the foreseeable future. Some of the ongoing and recently completed salvage/sanitation activities have altered hiding cover (Lucky Logger, Low Wood 2), while others (Winter Blowdown) have not likely altered hiding cover due to the nature of the salvaged material. The proposed precommercial thinning project could alter approximately 180 acres of hiding cover within the subunit. No activities are proposed on USFS lands that would alter grizzly bear hiding cover; meanwhile, some activities could occur on Plum Creek lands that could affect grizzly bear hiding cover. The reductions associated with this project would be additive to past losses from timber harvesting, as well as planned salvage/sanitation harvesting and precommercial thinning. Hiding cover reductions associated with timber harvesting and thinning are short-lived (10 to 20 years) and recovery of hiding cover in the general vicinity is fairly rapid. Under the SVGBCA, all cooperators are required to maintain a minimum of 40 percent hiding cover on their individual lands. The proposed harvesting would reduce the amount of hiding cover on all DNRC-managed lands in the cumulative-effects analysis area from 78.2 percent to between 64.1 and 68.1 percent, and across all ownerships in the cumulative-effects analysis area, from 79.0 percent to between 74.6 and 75.6 percent, all of which would exceed the 40-percent minimum threshold established in the SVGBCA. Collectively, Action Alternatives B and C would reduce more hiding cover than Action Alternative D; therefore, slightly fewer effects would be anticipated with Action Alternative D. Thus, minor adverse cumulative effects to hiding cover that would affect grizzly bears in the cumulative-effects analysis area for 10 to 30 years would be anticipated since:

1) hiding cover would be reduced on DNRC-managed lands at the levels proposed and
2) adequate hiding cover would persist on all ownerships and across the subunit at levels exceeding the 40-percent requirement of the SVGBCA.

Open-road density

No changes to open roads or open-road densities would be anticipated. No ongoing salvage/sanitation, proposed salvage/sanitation, or proposed precommercial thinning on DNRC-managed lands would alter open-road densities. No activities are proposed on USFS lands that would alter open-road densities. Any activities that could occur on Plum Creek lands could alter total road densities, but changes to open roads would not be expected. The 30.7 percent of the subunit with an open-road density greater than 1 mile per square mile would remain below the 33-percent maximum threshold for open-road densities as established within the SVGBCA. Thus, no further cumulative effects to open-road densities or, subsequently, grizzly bears would be anticipated that would affect grizzly bears in the cumulative-effects analysis area for the foreseeable future since:

1) open-road densities would not change and
2) the amount of the subunit with an open-road density greater than 1 mile per square mile would continue to be below the maximum threshold established under the SVGBCA.

Security habitat

No changes to open roads or the potential for human-caused mortality would be anticipated. Minor reductions in security habitat would reduce the amount of the cumulative-effects analysis area providing security habitat from 25.9 percent to between 24.1 and 25.4 percent, with the greatest reduction being associated with Action Alternative B, and the least reduction being associated with Action Alternative C. Proposed road construction would increase the total road densities from 75.0 to between 75.8 and 76.5 percent, with the greatest increase being associated with Action Alternative B, and the least increases being associated with Action Alternatives C and D (*TABLE W-13 – GRIZZLY BEAR HABITAT PARAMETERS - CUMMULATIVE-EFFECTS ANALYSIS AREA*). Use of the restricted roads in the cumulative-effects analysis area would increase substantially during the 3-year active period and then revert to levels similar to current levels for another inactive period. Proposed harvesting would alter 860 to 1,565 acres of spring habitats in the linkage zone, with the largest reductions being associated with Action Alternative C, and the smallest reductions being associated with Action Alternative D (*TABLE W-13 – GRIZZLY BEAR HABITAT PARAMETERS - CUMMULATIVE-EFFECTS ANALYSIS AREA*). Since no stipulations for total road density or secure habitat are noted in the SVGBCA, all alternatives would be in compliance. The increases in total road density and accessibility of existing roads that would be reconstructed, and the decrease in secure habitat could result in increased disturbance of grizzly bears by nonmotorized dispersed recreation, administrative activities (including motorized), salvage harvests during inactive periods, and commercial forest-management activities during active periods. The increase in total-road density and decrease in secure habitat could result in an increased risk of avoidance of suitable habitat and human/bear interactions, with the greatest increases being associated with Action Alternative B and the smallest increase being associated with Action Alternative C. However, stipulations placed on contractors and DNRC personnel that restrict carrying firearms reduce the risk of additional mortality associated with administrative use. The availability of newly constructed roads as well as the improvements made to 41.6 to 62.9 miles of existing roads could increase nonmotorized use in the cumulative-effects analysis area, with the greatest amount being associated with Action Alternatives B and D (*TABLE W-13 - GRIZZLY BEAR HABITAT PARAMETERS – CUMMULATIVE-EFFECTS ANALYSIS AREA*). However, this nonmotorized use would not be expected to grow substantially; therefore, the risk to bears associated with nonmotorized use would be minor.

Reductions in habitat quality and available habitats would be additive to losses associated with past harvesting on all ownerships in the cumulative-effects analysis area. No ongoing salvage/sanitation, proposed salvage/ sanitation, or proposed precommercial thinning on DNRC-managed lands would alter security habitats or total road densities, but could alter spring habitats in the linkage zone. No activities are proposed on USFS lands that would alter security habitats, total road densities, or spring habitats in the linkage zone. Any activities that may occur on Plum Creek could alter total road densities, security habitat, and/or the amount of spring habitats in the linkage zone. An increase in grizzly bear disturbance levels associated with commercial timber harvesting on DNRC-managed and, potentially, Plum Creek lands would be anticipated during this active period for the Porcupine Woodward Grizzly Bear Subunit. All alternatives would fully meet the stipulations in the SVGBCA. Action Alternative B, with the greatest reduction in security habitat, most reductions within the linkage zone, and lowest amount of newly constructed roads, coupled with intermediate amounts of hiding cover removed (see *HIDING COVER* under *GRIZZLY BEAR*), would be expected to contribute proportionally more effects and, therefore, risk to grizzly bears. Action Alternative D, with intermediate increases in total road densities, least amount of habitat affected in the linkage zone, and intermediate reductions in security habitat, coupled with the lowest amount of hiding cover removed, would be expected to have proportionally the least amount of effects to grizzly bears. Thus, low to moderate adverse cumulative effects to security habitats would be anticipated that would affect grizzly bears in the cumulative-effects analysis area for the foreseeable future since:

1) minor decreases in security habitats would be anticipated;
2) total road densities would increase by 0.8 to 1.5 percent;
3) increased disturbance caused by commercial harvesting would occur for 3 years during the nondenning period;
4) spring habitats in the linkage zone would be altered by 6.7 to 12.2 percent; and
5) SVGBCA mitigations would further reduce risks to grizzly bear security.

SENSITIVE SPECIES

When conducting forest-management activities, the SFLMP directs DNRC to give special consideration to sensitive species. These species may be sensitive to human activities, have special habitat requirements, are associated with habitats that may be altered by timber management, and/or may, if management activities result in continued adverse impacts, become listed under the *Federal Endangered Species Act*. Because sensitive species usually have specific habitat requirements, consideration of their needs serves as a useful "fine filter" for ensuring that the primary goal of maintaining healthy and diverse forests is met. The following sensitive species were considered for analysis. As shown in *TABLE W-14 - SENSITIVE SPECIES,* each sensitive species was either included in the following analysis or dropped from further analysis for various stated reasons.

- **Fisher**

Issue

The proposed activities could reduce the amount and/or quality of fisher habitats, which could alter fisher use of the area.

Introduction

Fishers are generalist predators that prey upon a variety of small mammals and birds, as well as snowshoe hares and porcupines. They also take advantage of carrion and seasonally available fruits and berries (*Foresman 2001*). Fishers use a variety of successional stages, but are disproportionately found in stands with dense canopies (*Powell 1982, Johnson 1984, Jones 1991, Heinemeyer and Jones 1994*) and avoid openings or young forested stands (*Buskirk and Powell 1994*). However, some use of openings does occur for short hunting forays or if sufficient overhead cover (shrubs, saplings) is present. Fishers appear to be highly selective of stands that contain resting and denning sites and tend to use areas within 150 feet of water (*Jones 1991*). Resting and denning sites are found in cavities of live trees and snags, downed logs, brush piles, mistletoe brooms, squirrel and raptor nests, and holes in the ground. Forest-management considerations for fisher involve providing for resting and denning habitats near riparian areas while maintaining travel corridors.

WILDLIFE ANALYSIS

TABLE W-14 - SENSITIVE SPECIES. Status of DNRC sensitive species for NWLO in relation to this project.

SPECIES	DETERMINATION – BASIS
Bald eagle (*Haliaeetus leucocephalus*)	No further analysis conducted – The project area is over 4 miles northwest of the nearest known bald eagle nest at Van Lake, over 4.5 miles from a nest on Station Creek near Flathead Lake, and over 5 miles from a nest near Swan Lake. No large waterbodies suitable for nesting are within 1 mile of the project area . Additionally, the project area is separated from the local nests by areas of unsuitable habitats. Thus, no direct, indirect, or cumulative effects to bald eagles would be expected to occur as a result of any alternative.
Black-backed woodpecker (*Picoides arcticus*)	No further analysis conducted – No recently (less than 5 years) burned areas or massive, widespread insect outbreaks are in the project area . Thus, no direct, indirect, or cumulative effects to black-backed woodpeckers would be expected to occur as a result of any alternative.
Coeur d'Alene salamander (*Plethodon idahoensis*)	No further analysis conducted – No moist talus or streamside talus habitat occurs in the project area . Thus, no direct, indirect or cumulative effects to Coeur d'Alene salamanders would be expected to occur as a result of any alternative.
Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*)	No further analysis conducted – No suitable grassland communities occur in the project area . Thus, no direct, indirect or cumulative effects to Columbian sharp-tailed grouse would be expected to occur as a result of any alternative.
Common loon (*Gavia immer*)	No further analysis conducted – Common loons have nested on Swan, Vann, and Flathead lakes in the past. None of these nests exist in 4.5 miles of the project area. No large lakes that could support loons exist in the project area. Thus, no direct, indirect or cumulative effects to common loons would be expected to occur as a result of any alternative.
Fisher (*Martes pennanti*)	**Included** – Potential fisher habitats occur in the project area .
Flammulated owl (*Otus flammeolus*)	No further analysis conducted – No suitable dry ponderosa pine and Douglas-fir habitats occur within the project area . No direct, indirect, or cumulative effects to flammulated owls would be expected to occur as a result of any alternative.
Harlequin duck (*Histrionicus histrionicus*)	No further analysis conducted – No suitable high-gradient stream or river habitats occur in the project area . No direct, indirect, or cumulative effects to harlequin ducks would be expected to occur as a result of any alternative.
Northern bog lemming (*Synaptomys borealis*)	No further analysis conducted – No suitable sphagnum bogs or fens occur in the project area . Thus, no direct, indirect or cumulative effects to northern bog lemmings would be expected to occur as a result of any alternative.
Peregrine falcon (*Falco peregrinus*)	No further analysis conducted – No suitable cliffs/rock outcrops occur in the project area or within 1 mile of the project area . Thus, no direct, indirect, or cumulative effects to peregrine falcons would be anticipated as a result of any alternative.

WILDLIFE ANALYSIS	
SPECIES	**DETERMINATION – BASIS**
Pileated woodpecker (*Dryocopus pileatus*)	**Included** – Western larch-Douglas-fir habitats occur in the project area that could provide foraging and nesting habitats.
Townsend's big-eared bat (*Plecotus townsendii*)	No further analysis conducted – No suitable caves or mine tunnels are known to occur in the project area . Thus, no direct, indirect, or cumulative effects to Townsend's big-eared bats would be anticipated as a result of any alternative.

Analysis Area

Direct and indirect effects were analyzed for activities conducted in the project area. For cumulative effects analysis purposes, the Porcupine Woodward Grizzly Bear Subunit was used (*ARM 36.11.440(1)(a)*). Considerable acreage in the cumulative-effects analysis area is managed by DNRC, USFS, and PLUM CREEK (*TABLE W-1 - PORCUPINE WOODWARD OWNERSHIP*). This scale includes enough area to approximate overlapping home ranges of male and female fishers (*Heinemeyer and Jones 1994*).

Analysis Methods

To assess potential fisher habitat and travel cover on DNRC-managed lands in the cumulative-effects analysis area, sawtimber stands within preferred fisher covertypes (*ARM 36.11.403(60)*) below 6,000 feet in elevation with 40 percent or greater canopy closure were considered potential fisher habitat. Fisher habitat was further divided into upland and riparian-associated areas depending on the proximity to streams and based on stream class. Direct and indirect effects were analyzed using field evaluations and GIS analysis of potential habitat. Cumulative effects were analyzed using field evaluations and GIS analysis of potential habitat, and aerial photograph interpretation of potential habitat was used on all other lands in the cumulative-effects analysis area. Factors considered include amount of suitable fisher habitats, landscape connectivity, and human access.

Existing Environment

The project area ranges from 3,160 to 6,200 feet in elevation, with nearly 12 miles of perennial streams and roughly 3 miles of intermittent streams. DNRC manages preferred fisher covertypes within 100 feet of Class 1 and 50 feet of Class 2 streams, so that 75 percent of the acreage (trust lands only) would be in the sawtimber size class in moderate to well-stocked density (*ARM 36.11.440(1)(b)(i)*). Approximately 304 acres are located in the riparian areas in the project area along the 15 miles of Class 1 and 2 streams. An estimated 4,932 acres of fisher habitat, potentially suitable for foraging, resting, denning, and travel activities, occur in the upland and riparian areas (4,715 upland acres and 217 riparian acres) in the project area. Much of the riparian areas are preferred fisher covertypes (217 of 304, or 72 percent), and much of the preferred fisher covertypes (181 of 217 acres, or 83 percent) are moderately or well-stocked and likely support the structural features necessary for use as fisher resting and denning habitats in addition to serving as travel habitats and maintaining landscape connectivity. Connectivity in the project area is relatively well maintained (see

CONNECTIVITY in this analysis). Additionally, motorized human access to the project area that could expose fisher to trapping pressure is restricted to a couple of open roads. Nonmotorized access exists on a fairly extensive network of restricted roads; however, motorized access is limited to administrative uses, and relatively large areas are free of any motorized access (see *SECURITY HABITAT* under *GRIZZLY BEAR* in this analysis).

At the cumulative-effects analysis-area level, approximately 2,292 acres of riparian areas are associated with 95 miles of perennial and 18 miles of intermittent streams in the Porcupine Woodward Grizzly Bear Subunit. This acreage is fairly evenly split between private owners (the majority is Plum Creek lands), USFS, and State. Approximately 83.8 percent (420 of 502 acres) of the DNRC-managed acreage in preferred fisher covertypes in the riparian areas currently supports moderate- to well-stocked densities of sawtimber, which exceeds the 75-percent threshold established in *ARM 36.11.440(1)(b)(i)*. Additionally, in the uplands, 71.4 percent (5,714 of 7,998 acres) of the DNRC-managed lands in preferred fisher covertypes currently support moderate- to well-stocked densities of sawtimber, indicating potential upland fisher habitats. Within the cumulative-effects analysis area, ongoing salvage/sanitation associated with the Winter Blowdown and Low Wood 2 salvage projects would continue altering upland fisher habitats; however, no riparian fisher habitats would be altered with any of these projects. The recently completed Lucky Logger Sanitation project also altered roughly 80 acres of upland fisher habitats. Additionally, the proposed DNRC precommercial thinning could alter stand conditions within preferred covertypes on 176 acres. Other SVGBCA cooperators (USFS and Plum Creek) have considerable acreage within the Porcupine Woodward Grizzly Bear Subunit used for the cumulative-effects analysis area (*TABLE W-1 - PORCUPINE WOODWARD OWNERSHIP*). Based on interpretation of aerial photographs for this larger area, approximately 19,383 acres of adjacent lands provide forested habitats with greater than 40-percent canopy closure, providing stand conditions that could support fisher habitat. The remaining 4,075 acres is comprised of younger stands, sparsely vegetated stands, and natural openings that do not meet structural requirements for fishers. No activities are proposed on USFS lands that would alter fisher habitats. Plum Creek Timber Company has lands within the subunit, and any harvesting that may occur on their lands could alter fisher habitats; however, DNRC is unaware of any specific plans. Landscape connectivity in the cumulative-effects analysis area is fairly intact, but has been diminished in places (see *CONNECTIVITY* in *WILDLIFE ANALYSIS*). Additionally, motorized human access to the project area is restricted to a couple of open roads, and nonmotorized access exists on a fairly extensive network of restricted roads; however, motorized access is limited to administrative uses and relatively large areas are free of motorized access (see *SECURITY HABITAT* under *GRIZZLY BEAR* in this analysis).

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Fishers***

No effects to fishers would be expected under this alternative. Little change to the 4,932 acres of potential fisher denning and foraging habitats would be expected. Habitats that are conducive to fisher denning and travel may improve due to increased tree growth and canopy closure; however, foraging opportunities may decline due to the lack of diversity in habitat such as edge and younger age-class stands. No changes in snag, snag recruit, or coarse woody debris levels would be anticipated. Landscape connectivity would not change. Motorized human access and potential trapping mortality would be expected to remain similar to current levels. Thus, no direct and indirect effects would affect fishers in the project area since:

1) no changes to existing habitats would be anticipated;
2) landscape connectivity would not be altered;
3) no appreciable changes to snags, snag recruits, and coarse woody debris levels would be anticipated; and
4) no changes to human access or the potential for trapping mortality would be anticipated.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Fishers***

Of the 4,932 acres of potential fisher habitats in the project area, 837 to 1,432 acres would be harvested, with the greatest reduction being associated with Action Alternative C, and the smallest reduction being associated with Action Alternative D (*TABLE W-15 – PROJECT AREA FISHER HABITATS)*. In each harvest unit, leave trees, at least 2 large snags, and 15 to 20 tons of coarse woody debris per acre would be retained, providing fisher habitat attributes. All Class 1 streams would have a no-harvest buffer of at least 100 feet, with larger buffers in place on Whitetail, Woodward, and South Woodward creeks to retain connectivity. Additionally, buffers of at least 50 feet would be applied on all Class 2 streams, further contributing to landscape connectivity, while avoiding harvesting in these riparian zones that are preferred fisher habitats. Therefore, those habitats in the riparian area adjacent to the Class 1 and 2 streams in the project area that are conducive to fisher denning, foraging, or traveling would not be altered with any alternative and would continue providing these attributes for fishers. Upland habitats, which are less frequently used by fisher, would be harvested with all action alternatives leading to reduced quantity and quality of fisher habitats on 837 to 1,432 acres, depending on alternative (*TABLE W-15 – PROJECT AREA FISHER HABITATS*). In the seedtree and shelterwood harvest units, timber harvesting would reduce canopy closure to less than 40 percent and remove understory vegetation to provide for seedling establishment. Since fishers avoid stands with less than 40-percent canopy closure (*Jones 1991*) and areas that lack overhead cover (*Buskirk and Powell 1994*), these silvicultural prescriptions would result in a loss of habitat for 10 to 20 years. After this time, regeneration of conifer trees would be expected to provide overhead cover, which would allow for fisher use. Retention of snag-recruitment trees and a minimum of 2 large snags per acre could provide denning or resting sites between the time the stands develop overhead cover and when the stands develop to a point of starting to produce large snags again. As stands mature in 70 to 100 years, canopy cover and additional structure in the form of large trees, snags, and coarse woody debris would reestablish. Additionally, in these regeneration units, a number of unharvested patches of at least 1.6 acres would be retained so that no point of the unit exceeds 600 feet to cover as required under the SVGBCA; these patches could aid fisher movements in the future if left unharvested. Minor changes in covertypes (see *COVERTYPE* in *WILDLIFE ANALYSIS*) caused by these regeneration treatments would, through time, provide slight increases in the amount of preferred fisher covertypes in the

TABLE W-15 – PROJECT AREA FISHER HABITATS. Acres of habitats modified or removed as a result of each alternative, acres of fisher habitats following the proposed harvesting, and changes in preferred fisher covertypes available within the project area.

FISHER HABITAT		ALTERNATIVES			
		A	B	C	D
Acres of habitat removed and (percentage) of project area fisher habitats [1, 3]	Upland	0	1,067 (29.9)	1,287 (36.0)	735 (20.6)
	Riparian	0	0	0	0
Acres of habitat altered and (percentage) of project area fisher habitats [2, 3]	Upland	0	133 (3.7)	145 (4.1)	102 (2.9)
	Riparian	0	0	0	0
Total acres of fisher habitats affected and (percentage) of project area fisher habitats [2, 3]	Upland	0	1,200 (33.6)	1,432 (40.1)	837 (23.4)
	Riparian	0	0	0	0
	Total	*0*	*1,200 (33.6)*	*1,432 (40.1)*	*837 (23.4)*
Acres and (percentage) of fisher habitat in the project area following implementation of each alternative [3]	Upland	3,393 (100)	2,326 (68.6)	2,106 (62.1)	2,658 (78.3)
	Riparian	181 (100)	181 (100)	181 (100)	181 (100)
Acres of upland preferred covertypes removed		0	12	38	20
Acres of upland preferred covertypes to develop with stand covertype conversions [4]		0	11	50	82

[1] *Proposed prescription includes seedtree and shelterwood-type treatments where canopy closure after harvesting would likely be less than 40 percent.*

[2] *Proposed prescription includes variable thin where canopy closure after harvesting would likely be greater than 40 percent.*

[3] *A total of 3,393 acres of upland and 181 acres of riparian fisher habitats in the preferred covertypes meet the structural requirements of fisher in the project area.*

[4] *Covertype conversions would lead to the establishment of additional acres in preferred covertypes after the implementation of any action alternative. This includes the loss of preferred covertypes associated with the proposed 22-acre gravel pit development.*

project area by 11 to 82 acres, with the greatest improvement being associated with Action Alternative D, and the least improvement being associated with Action Alternative B (*TABLE W- 15 – PROJECT AREA FISHER HABITATS*). However, these would be partially offset by the loss of 22 acres of preferred covertypes associated with the gravel pit development. Meanwhile, units prescribed for variable-thin prescriptions would retain a minimum of 40-percent canopy cover and would continue to be available as potential fisher habitat, although at a reduced quality. Fisher habitat quality would be expected to decrease with the loss of denning/ resting structure and prey habitat due to the reductions in snag densities and the subtle increases in coarse woody debris levels that are largely skewed towards the smaller-sized pieces that are less suitable for use by fisher and their prey. However, mitigation measures would include the retention of large snags and coarse woody debris; thereby, important habitat components would likely be retained, albeit at lower levels of snags, and would include many more lower-quality pieces of coarse woody debris. The length of time these reductions would last depends on the growth rate of the retention trees and resting/ denning habitat development (snags and coarse woody debris). In general, units proposed to receive seedtree and shelterwood prescriptions would result in decreased habitat availability for at least 70 to 100 years, while units proposed to receive variable thin treatments would retain usable habitat, albeit of lesser quality, following harvesting. Forest connectivity around the openings created with these alternatives would be largely maintained through riparian buffers and other forested habitats in the project area not altered, but overall connectivity would be reduced to varying levels depending upon alternative (see *CONNECTIVITY* in *WILDLIFE ANALYSIS*). Minor changes to human motorized disturbance levels or potential trapping mortality would be expected because open road densities would not change, but the existence of closed roads might facilitate some increases in trapping pressure. Thus, minor adverse direct and indirect effects would be anticipated under Action Alternative D and moderate direct and indirect effects would be anticipated under Action Alternatives B and C that would affect fisher in the project area for 70 to100 years under all action alternatives since:

1) harvesting would avoid riparian areas;
2) harvesting would reduce or remove upland fisher habitats and mature upland stands in preferred covertypes;
3) motorized human access levels, particularly in riparian areas, and trapping mortality potential would not change;
4) harvesting would reduce snag and coarse woody debris levels; however, some of these resources would be retained;
5) landscape connectivity would be altered, but those areas associated

with riparian areas would remain unaffected; and

6) minor amounts of the project area would be converted to preferred fisher covertypes.

- ***Cumulative Effects of No-Action Alternative A to Fishers***

Fisher habitats, preferred covertype stocking, and habitat connectivity in the project area would remain relatively unchanged in the short term. Fisher habitats on DNRC-managed lands in the cumulative-effects analysis area would remain at 5,714 acres (71.4 percent) in the uplands and 420 acres (83.8 percent) associated with the riparian areas. Road access in the cumulative-effects analysis area would not change; therefore, human disturbance and fisher vulnerability to trapping would remain unchanged. In the longer term, fisher habitat and the percentage of fisher habitat in the uplands and associated with riparian areas would increase as stands developed more overhead cover; resting/denning structure would develop as trees increase in size, die, and fall to the ground. Landscape connectivity would not change appreciably, but some improvement with successional advances could provide slight improvements in connectivity within the cumulative-effects analysis area. Thus, minor positive cumulative effects to fishers would be anticipated in the cumulative-effects analysis area since:

1) no changes to existing habitats on DNRC-managed ownership would occur;
2) landscape connectivity afforded by the stands on DNRC-managed ownership would not appreciably change;
3) no changes to snags, snag recruits, or coarse woody debris levels would be expected; and
4) no changes to human access or the potential for trapping mortality would be anticipated.

- ***Cumulative Effects to Fishers Common to Action Alternatives B, C, and D***

All action alternatives would harvest upland fisher habitats while reducing snags and coarse woody debris, and would lead to a slight increase in preferred fisher covertypes. On DNRC-managed lands within the cumulative-effects analysis area, available fisher habitat in the uplands would decline from 5,714 acres (71.4 percent) to between 4,427 (55.0 percent) and 4,979 acres (61.6 percent); a reduction between 9.1 and 16.5 percent in habitat (*TABLE W-16 - FISHER HABITATS- CUMMULATIVE-EFFECTS ANALYSIS AREA*). Additionally, habitat quality would be reduced on between 102 and 145 acres (1.3 to 1.8 percent of existing habitat). However, no changes would be anticipated in the riparian habitats, and under all action alternatives, 83.8 percent of preferred fisher covertypes on DNRC-managed lands would continue providing structural features that facilitate fisher use, which would continue to exceed the 75-percent threshold established in *ARM 36.11.440(1)(b)(i)*. Slight increases in preferred fisher covertypes over time on DNRC-managed lands would be possible with the regeneration

***TABLE W-16 - FISHER HABITATS - CUMMULATIVE-EFFECTS ANALYSIS AREA.** Acres of preferred covertypes [a] and fisher habitats [b] on DNRC-managed lands in the cumulative-effects analysis area following each alternative.*

FISHER HABITAT	ALTERNATIVES			
	A	B	C	D
Acres of upland preferred fisher covertypes [1]	7,998	8,009	8,048	8,080
Total acre reduction in upland fisher habitats [2]	0	1,067	1,287	735
Acres of upland fisher habitats [2]	5,714	4,647	4,427	4,979
Percent of upland portions of subunit in fisher habitats [2]	*71.4*	*58.0*	*55.0*	*61.6*
Total reduction in riparian fisher habitats [2]	0	0	0	0
Acres of preferred covertypes in riparian areas [1]	502	502	502	502
Acres of riparian fisher habitats [2]	420	420	420	420
Percent of subunit in riparian fisher habitats [2]	*83.8*	*83.8*	*83.8*	*83.8*

[1] Preferred covertypes are selected types used by fisher - this includes all stand stages.
[2] Fisher habitats are those lands in preferred covertypes that are in the sawtimber size class in moderate to well-stocked density.

treatments converting the covertypes of some stands in the project area. No losses in the amount of riparian fisher habitats would occur, but would be partially offset by the loss of 22 acres of preferred covertypes with the proposed gravel pit development. Any reductions in fisher habitats would be additive to past losses associated with timber harvesting within the cumulative-effects analysis area, including past salvage (Lucky Logger Sanitation Project) and ongoing salvage/sanitation projects (Low Wood and Winter Blowdown); however, no riparian fisher habitats would be altered with any of these projects. Additionally, habitat connectivity would be maintained along the streams and ridges and across third-order drainages (*ARM 36.11.441[1][c]*). The proposed DNRC precommercial thinning on 176 acres could alter stand conditions within preferred covertypes.

Aerial photograph interpretation estimated that approximately 19,383 of 23,458 acres (82.6 percent) of non-DNRC-managed lands in the cumulative-effects analysis area presently exhibit closed-canopied conditions, and unknown, but a relatively high proportion of those acres, are expected to meet minimum habitat requirements of tree size and density for use by fisher. The remaining 4,075 acres are comprised of younger stands, sparsely vegetated stands, and natural openings that likely do not meet habitat needs of fishers. No activities are proposed on USFS lands that would alter fisher habitats. Some activities could occur on Plum Creek lands that could alter fisher habitats. Further reductions to landscape connectivity would be anticipated (see *CONNECTIVITY* in this analysis); however, changes to connectivity would not prevent fisher movements. A range of 9.5 to 14.0

miles of new roads would be constructed, depending on alternative. Motorized access in conventional passenger vehicles that could increase fisher vulnerability to trapping would not be expected to change under any action alternative; however, given that the fisher trapping season overlaps the winter months when snowmobiles could access these newly constructed roads, as well as the 41.6 to 62.9 miles of roads to be improved, some minor increases in motorized human access would be possible during the fisher trapping season, which could increase fisher vulnerability to trapping. However, these newly constructed roads would largely avoid riparian habitats where fishers are more commonly found. Thus, minor adverse cumulative effects would be anticipated under Action Alternative D and moderate cumulative effects would be anticipated under Action Alternatives B and C that would affect fisher in the project area for 70 to100 years since:

1) harvesting would remove upland fisher habitats and mature upland stands in preferred fisher covertypes, but considerable upland habitats would persist;
2) no changes to preferred covertypes or fisher habitats associated with the numerous riparian areas in the cumulative-effects analysis area would be anticipated;
3) landscape connectivity would be reduced, but not to a level that would appreciably disrupt fisher movements;
4) harvesting would partially reduce snags and snag recruits, while increasing the coarse woody debris levels, largely in the smaller-sized pieces;
5) no appreciable changes to motorized human access, but slight increases in snowmobile access might increase fisher vulnerability to trapping mortality; and
6) negligible changes in the amount of preferred covertypes on DNRC-managed lands within the cumulative-effects analysis area would be anticipated.

- **Pileated Woodpecker**

Issue

The proposed activities could reduce suitable nesting and foraging habitat for pileated woodpeckers, which could alter pileated woodpecker use of the area.

Introduction

Pileated woodpeckers play an important ecological role by excavating cavities that are used in subsequent years by many other species of birds and mammals. Pileated woodpeckers excavate the largest cavities of any woodpecker. Preferred nest trees are western larch, ponderosa pine, cottonwood, and quaking aspen, usually 20 inches dbh and larger. Pileated woodpeckers primarily eat carpenter ants, which inhabit large downed logs, stumps, and snags. *Aney and McClelland (1985)* described pileated nesting habitat as "...stands of 50 to 100 contiguous acres, generally below 5,000 feet in elevation with basal areas of 100 to 125 square feet per acre and a relatively closed canopy." The feeding and nesting habitat requirements, including large snags or decayed trees for nesting and downed wood for feeding, closely tie these woodpeckers to mature forests with late-successional characteristics. The density of pileated woodpeckers is positively correlated with the amount of dead and/or dying wood in stands (*McClelland 1979*).

Analysis Area

Direct and indirect effects were analyzed for activities conducted in the project area. For cumulative-effects analysis purposes, the Porcupine Woodward Grizzly Bear Subunit was used as the scale of the analysis. This scale includes enough area to support several pairs of pileated woodpeckers (*Bull and Jackson 1995*). More information regarding the Porcupine Woodward Grizzly Bear Subunit can be found under *GRIZZLY BEAR*.

Analysis Methods

To assess potential pileated woodpecker nesting habitats on DNRC-managed lands in the cumulative-effects analysis area, SLI data were used to identify sawtimber stands with more than 100 square feet basal area per acre, were older than 100 years old, had greater than 40-percent canopy closure, and were occurring below 5,000 feet in elevation. Foraging habitats are areas that do not meet the definition above, but include the remaining sawtimber stands below 5,000 feet in elevation with greater than 40-percent canopy cover. To assess habitat on other ownerships within the cumulative-effects analysis area, aerial photographs were interpreted to assess forest stands. Where stands appeared to meet the minimum potential foraging habitat, pileated woodpecker habitat was assumed present. Potential foraging and nesting habitat were not differentiated on other ownerships for this analysis due to data limitations. Direct and indirect effects as well as cumulative effects were analyzed using a combination of field evaluation, aerial photograph interpretation, and these mapped potential habitats. Factors considered included the amount of potential habitat, degree of harvesting, and the amount of continuous forested habitat.

Existing Environment

In the project area, potential pileated woodpecker nesting habitat exists on approximately 1,651 acres. These nesting habitats are dominated by western larch/ Douglas-fir and mixed conifers. Additionally, 1,784 acres of sawtimber stands dominated by western red cedar and grand fir that are potential foraging habitats exist in the project area, along with approximately 1,649 acres of nonsawtimber-sized stands that are largely western larch/Douglas-fir types, which might provide lower quality foraging habitats. Although nesting habitat is defined differently than foraging habitat, nesting habitat also provides foraging opportunities for pileated woodpeckers.

Removal of large western larch by past timber-harvesting activity has reduced the quality of habitat for pileated woodpeckers. Large live and dead trees are less common than would occur naturally due to these past timber-harvesting activities in portions of the project area. Black cottonwood occurs in some of the riparian areas in the project area. Large (greater than 21 inches dbh) western larch exist in the project area, which could become suitable nesting sites, and existing Douglas-fir/western larch and mixed-conifer stands are likely providing foraging habitats. In the project area, 8.8 medium-sized (15 to 20 inch dbh) snags per acre and 3.4 large-sized (greater than 21 inches dbh) snags per acre exist (see *WILDLIFE ANALYSIS—SNAGS*). During field visits, many feeding sites were observed in the project area.

In the cumulative-effects analysis area, potential pileated woodpecker nesting habitat exists on approximately 2,831 acres (23.1 percent) of DNRC-managed lands. Similar to the project area, these nesting habitats are dominated by western larch/Douglas-fir and mixed conifers. Additionally, 3,602 acres (29.4 percent) of sawtimber stands dominated by western red cedar, grand fir, lodgepole pine, and Engelmann spruce exist on DNRC-managed ownership within the cumulative-effects analysis area; these stands are potential foraging habitats, along with approximately 3,400 acres (27.8 percent) of nonsawtimber-sized stands in largely western larch/Douglas-fir types that might provide lower quality foraging habitats. Within the cumulative-effects analysis area, ongoing salvage associated with the Winter Blowdown Salvage Project (240 acres of mostly blowdown, but approximately 10 acres of dead standing timber is included) and Low Wood Sanitation Project (60 acres) would continue altering pileated woodpecker habitats, and the recently completed Lucky Logger Sanitation Project reduced pileated nesting and foraging habitats on 66 acres; however, these projects would retain snags, snag recruits, and coarse woody debris. Additionally, the proposed DNRC precommercial thinning on 176 acres could alter future pileated woodpecker habitats by manipulating species composition. Other SVGBCA cooperators (USFS and Plum Creek) have considerable acreage in the Porcupine Woodward Grizzly Bear Subunit used for the cumulative-effects analysis area (*TABLE W-1 - PORCUPINE WOODWARD OWNERSHIP*). Based on interpretation of aerial photographs for this larger area, approximately 19,383 acres of adjacent lands provide forested habitats with greater than 40-percent canopy closure, providing stand conditions that could support some pileated woodpecker use. The remaining 4,075 acres are comprised of younger stands, sparsely vegetated stands, and natural openings that do not meet habitat needs of pileated woodpeckers. No activities are proposed on USFS lands that would alter pileated woodpecker habitats. Plum Creek has lands in the subunit, and any harvesting that may occur on their lands could alter pileated woodpecker habitats; however, no specific plans are known.

Environmental Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Pileated Woodpeckers***

  No disturbance of pileated woodpeckers would occur. Forest succession and natural disturbance agents would continue to bring about changes in existing stands. Trees would continue to grow, mature, and die, thus providing potential nesting and foraging structure for pileated woodpeckers. Continual conversion to shade-tolerant species would reduce the quality of habitat for pileated woodpeckers over time. Therefore, a reduction in suitable nesting trees would be likely over time, which could lead to decreased reproduction in the project area. Thus, negligible adverse indirect effects to pileated woodpeckers in the project area would be expected until some other disturbance reverses stand succession since:

1) no further harvesting would occur;
2) no changes in the amount of continuously forested habitats would be anticipated;
3) no appreciable changes to existing pileated woodpecker habitats would be anticipated; and
4) long-term, succession-related declines in the abundance of shade-intolerant tree species, which are valuable to pileated woodpeckers, would be anticipated.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Pileated Woodpeckers***

Pileated woodpeckers tend to be tolerant of human activities (*Bull and Jackson 1995*), but could be temporarily displaced by the proposed harvesting and road-building activities. Harvesting between 1,187 and 1,565 acres would reduce continuous forested habitats for pileated woodpeckers. Between 411 and 665 acres of potential nesting, plus an additional 543 to 773 acres of potential foraging habitat, would be modified, with the greatest effect being associated with Action Alternative C and the least reduction occurring under Action Alternative D (*TABLE W-17 - PROJECT AREA PILEATED WOODPECKER HABITATS*). An additional 22 acres of potential future habitats would be lost with the proposed gravel pit

TABLE W-17 – PROJECT AREA PILEATED WOODPECKER HABITATS. Changes in pileated woodpecker nesting and foraging habitats under each alternative in the project area.

PILEATED WOODPECKER HABITAT	ALTERNATIVES			
	A	B	C	D
Acres of nesting habitat removed [1]	0	463	620	362
Acres of nesting habitat altered [2]	0	168	45	49
Total acres of nesting habitat modified	*0*	*631*	*665*	*411*
Total acres of nesting habitat on the project area postharvest (percent reduction)	*1,651 (0)*	*1,188 (28.0)*	*1,031 (37.6)*	*1,289 (21.9)*
Acres of foraging habitat removed [1]	0	583	719	510
Acres of foraging habitat altered [2]	0	64	54	33
Total acres of foraging habitat modified	*0*	*647*	*773*	*543*
Total acres of foraging habitat on the project area postharvest (percent reduction)	*1,784 (0)*	*1,201 (32.7)*	*1,065 (40.3)*	*1,274 (28.6)*
Total acres of nesting and foraging habitats altered [2]	*0*	*232*	*99*	*82*
Total acres of nesting and foraging habitats removed [1]	*0*	*1,046*	*1,339*	*872*
Total acres of nesting and foraging habitat on the project area postharvest (percent reduction)	*3,435 (0)*	*2,389 (30.5)*	*2,096 (39.0)*	*2,563 (25.4)*

[1] *Proposed prescription includes seedtree and shelterwood type treatments where canopy closure after harvest would likely be less than 40 percent.*

[2] *Proposed prescription includes variable thin, where canopy closure after harvest would likely be greater than 40 percent.*

development. Where regeneration harvests are proposed, potential pileated nesting and foraging habitats would be removed for 30 to 100 years, depending on the density of trees retained. In units proposed to receive variable-thin treatments, pileated woodpecker habitat would likely retain a minimum of 40-percent canopy cover, but the number of small and medium snags could be reduced substantially, and large snags could potentially be reduced from 3.4 to 2.0 per acre (or an approximate 41-percent reduction in large snags). Elements of the forest structure important for nesting pileated woodpeckers, including snags (a minimum of 2 snags greater than 21 inches dbh per acre), coarse woody debris (15 to 20 tons per acre), numerous leave trees, and snag recruits (a minimum of 2 trees per acre greater than 21 inches dbh) would be retained in the proposed units. Since pileated woodpecker density is positively correlated with the amount of dead and/or dying wood in a stand (*McClelland 1979*), pileated woodpecker densities in the project area would be expected to be reduced with all alternatives. The silvicultural prescriptions would retain healthy western larch, western white pine, and Douglas-fir while promoting the regeneration of these same species, which would benefit pileated woodpeckers in the future by providing nesting, roosting, and foraging habitats. Action Alternative D would reduce the least amount of nesting and foraging habitats, while Action Alternative C would alter the greatest amounts of nesting and foraging habitats; therefore, slightly fewer effects would be anticipated under Action Alternative D. Thus, minor direct and indirect effects would be anticipated under Action Alternative D and moderate direct and indirect effects would be anticipated under Action Alternatives B and C that would affect pileated woodpeckers in the project area for 30 to 100 years since:

1) harvesting would reduce the amount of continuous forested habitats available;
2) potential nesting and foraging habitats would be reduced;
3) several snags and snag recruits per acre would be removed; however mitigation measures to retain a minimum of 2 snags per acre and 2 snag recruits per acre would be included; and
4) harvest prescriptions would promote seral species in the proposed units.

- ***Cumulative Effects of No-Action Alternative A to Pileated Woodpeckers***

No disturbance of pileated woodpeckers would occur. Trees would continue to grow, mature, and die, thus providing potential nesting and foraging structure for pileated woodpeckers. Existing pileated woodpecker habitats on DNRC-managed ownership would persist. Continued widespread use of the cumulative-effects analysis area by pileated woodpeckers would be expected. Thus, negligible adverse cumulative effects to pileated woodpeckers in the cumulative effects analysis area would be expected since:

1) no further changes would occur to existing habitats on DNRC-managed ownership;
2) no changes to the amount of continuously forested habitats available for pileated woodpeckers would be anticipated; and
3) long-term, succession-related declines in the abundance of shade-intolerant tree species, which are valuable to pileated woodpeckers, would occur.

- ***Cumulative Effects to Pileated Woodpeckers Common to Action Alternatives B, C, and D***

Potential nesting habitat would be reduced to between 2,211 and 2,469 acres (representing a reduction of 12.8 to 21.9 percent) on DNRC-managed lands in the cumulative-effects analysis area, with the greatest reduction associated with Action Alternative C and the smallest reduction in habitats being associated with Action Alternative D (*TABLE W-18 - PILEATED WOODPECKER HABITATS - CUMMULATIVE-EFFECTS ANALYSIS AREA*). Similarly, foraging habitats would be reduced to between 2,883 and 3,092 acres (representing a 14.2- to 19.7-percent reduction from current levels), with the greatest reduction being associated with Action Alternative C and the smallest reduction of habitats being associated with Action Alternative D. The quality of potential nesting habitat would be reduced on another 45 to 168 acres (1.6 to 5.9 percent) of the habitats on DNRC-managed lands, and quality of potential foraging habitats would be reduced on another 33 to 64 acres (0.9 to 1.8 percent) of the habitats on DNRC-managed lands, with the greatest levels of modification occurring with Action Alternative B and the lowest levels of habitat modifications being associated with

TABLE W-18 –PILEATED WOODPECKER HABITATS - CUMMULATIVE-EFFECTS ANALYSIS AREA. Amounts of pileated woodpecker habitats modified, removed, and retained on DNRC-managed lands within the cumulative-effects analysis area under each alternative.

PILEATED WOODPECKER HABITAT	ALTERNATIVES			
	A	B	C	D
Acres of modified nesting habitat (percent)	0	168 (5.9)	45 (1.6)	49 (1.7)
Acres of nesting habitat removed (percent)	0	463 (16.4)	620 (21.9)	362 (12.8)
Amount of pileated nesting habitat unaffected (percent)	*2,831 (100)*	*2,200 (77.7)*	*2,166 (76.5)*	*2,420 (85.5)*
Acres of modified foraging habitat (percent)	0	64 (1.8)	54 (1.5)	33 (0.9)
Acres of foraging habitat removed (percent)	0	583 (16.2)	719 (19.7)	510 (14.2)
Amount of pileated foraging habitat unaffected (percent)	*3,602 (100)*	*2,955 (82.0)*	*2,829 (78.5)*	*3,059 (84.9)*

Action Alternative D (*TABLE W-18 - PILEATED WOODPECKER HABITATS - CUMMULATIVE-EFFECTS ANALYSIS AREA*). Although potential habitat would be reduced under this alternative, much of the remaining habitat contains high densities of snags that provide foraging and nesting structure. Elements of the forest structure important for nesting pileated woodpeckers, including snags (a minimum of 2 snags greater than 21 inches dbh per acre), coarse woody debris (15 to 20 tons per acre), numerous leave trees, and snag recruits (a minimum of 2 trees per acre greater than 21 inch dbh) would be retained in the proposed units to provide foraging and nesting structure when the canopy closure recovers to the point of allowing pileated woodpecker use. Many of these stands would be expected to regenerate with a high proportion of western larch, western white-pine, and Douglas-fir, which could provide nesting and feeding structural components in 80 to 120 years, thereby improving pileated woodpecker habitat. Future pileated woodpecker habitats would be lost on the proposed 22-acre gravel pit. Within the cumulative-effects analysis area, ongoing salvage associated with the Winter Blowdown Salvage Project (240 acres of mostly blowdown, but approximately 10 acres of dead standing timber is included) and Low Wood Sanitation Project (60 acres) would continue altering pileated woodpecker habitats, and the recently completed Lucky Logger Sanitation Project reduced pileated nesting and foraging habitats on 66 acres; however, snags, snag recruits, and coarse woody debris would be retained with these projects. Additionally, the proposed DNRC precommercial thinning on 176 acres could alter future pileated woodpecker habitats by manipulating species composition. Some pileated woodpecker habitats likely exist in most portions of the 19,383 acres of USFS and Plum Creek lands that are presently exhibiting closed-canopied conditions. The remaining 4,075 acres are comprised of younger stands, sparsely vegetated stands, and natural openings that likely do not currently meet habitat needs of pileated woodpeckers. No activities are proposed on USFS lands that would alter pileated woodpecker habitats; meanwhile, some activities could occur on Plum Creek lands that could alter pileated woodpecker habitats. The reductions and modifications associated with this project would be additive to past losses from timber harvesting and human development, as well as any potential ongoing reductions on Plum Creek lands. However, continued widespread use of the cumulative-effects analysis area by pileated woodpeckers during and following completion of any of the action alternatives would be expected. Therefore, Action Alternative D would reduce the least amount of nesting and foraging habitats, while Action Alternative C would alter the greatest amounts of nesting and foraging habitats; therefore, Action Alternative D would have proportionally fewer effects to pileated woodpecker nesting and foraging habitats. Thus, minor cumulative effects would be anticipated under Action Alternative D and moderate cumulative effects would be anticipated under Action Alternatives B and C that would affect pileated woodpeckers in the cumulative-effects analysis area for 30 to 100 years since:

1) harvesting would further reduce the amount of continuous forested habitats;
2) potential nesting and foraging habitats would be reduced;
3) snags and snag recruits in the cumulative-effects analysis area would be reduced and coarse woody debris levels would increase, but much of this increase would be in the smaller size classes, which are of lower quality to pileated woodpeckers; however, mitigation measures to retain a minimum of 2 snags per acre and 2 snag recruits per acre would be included; and
4) prescriptions would promote seral species in the proposed units.

BIG GAME

ISSUES

Big Game Winter Range

The proposed activities could remove forest cover on important winter ranges, which could lower their capacity to support white-tailed deer and elk.

Elk Security Habitat

The proposed activities could remove elk security cover, which could affect hunter opportunity and the local quality of recreational hunting.

INTRODUCTION

Big game species in northwest Montana that are commonly hunted and relevant to this project include white-tailed deer and elk. Extensive recreational opportunities exist for these species, and these activities contribute substantial economic contributions to the economy.

Big Game Winter Range

When considering populations of big game species, the winter-range component of their habitat is often a limiting factor in driving big game populations. These winter ranges enable big game survival by minimizing the effects of severe winter weather conditions. Winter ranges tend to be restricted low-snow zones and areas within a landscape that support concentrations of big game, which are more widely distributed during the remainder of the year. Desirable forest stand characteristics on winter ranges in western Montana include adequate midstory and overstory cover to reduce wind velocity and intercept snow, while moderating ambient temperatures. Besides providing a moderated climate, the snow-intercept capacity effectively lowers snow depths, which enables big game movement and access to forage and reduces their expenditure of energy. This is particularly important during severe winters when deer are under extreme levels of stress.

Elk Security Habitat

Timber harvesting can increase elk vulnerability by changing the size, structure, juxtaposition, and accessibility of areas that provide security during hunting season (*Hillis et al. 1991*). As visibility and accessibility increase within forested landscapes, elk and deer have a greater probability of being observed and, subsequently, harvested by hunters. Because the female segments of the elk and deer populations are normally regulated carefully during hunting seasons, primary concerns are related to a substantial reduction of the male segment and the subsequent decrease in hunter opportunity. The presence of fewer males at the beginning of the hunting season reduces the odds of a hunter seeing or harvesting such an animal throughout the remainder of the season.

ANALYSIS AREA

Big Game Winter Range

Direct and indirect effects were analyzed for activities conducted in the project area. Cumulative effects were analyzed on the 3,606 acres of mapped white-tailed deer winter range in the Porcupine Woodward Grizzly Bear Subunit. This cumulative-effects analysis area provides enough area to provide winter habitat for several hundred wintering white-tailed deer (*J. Vore, DFWP, personal communication, June 2, 2008*). More information regarding the Porcupine Woodward Grizzly Bear Subunit can be found under *GRIZZLY BEAR* in this analysis.

Elk Security Habitat

Direct and indirect effects were analyzed on the project area. Cumulative effects were analyzed on the Porcupine Woodward Grizzly Bear Subunit. This cumulative-effects analysis area should provide enough area for an elk herd to avoid hunting pressure during the general hunting season and approximates the size of an elk herd's fall home range. More information regarding the Porcupine Woodward Grizzly Bear Subunit can be found under *GRIZZLY BEAR*.

ANALYSIS METHODS

Big Game Winter Range

Area biologists for DFWP mapped big game winter ranges across the State. Direct and indirect, as well as cumulative effects, were analyzed using field evaluations, aerial photograph interpretation, and a review of habitat components. Factors considered in the analysis include the amount of winter range removed, amount of mature forested habitats retained on the winter range, and level of human disturbance.

Elk Security Habitat

Given that areas within 0.5 mile of an open road do not provide elk security habitat (*Hillis et al. 1991*), existing open roads and proposed new roads that would remain open to the public were buffered 0.5 mile and identified as areas not meeting the criteria for elk security habitat. Areas that were recently harvested within the cumulative-effects analysis area were not expected to provide security habitat and were removed from potential security cover. Additionally, elk security habitat patches need to be somewhat larger forested blocks (greater than 250 acres) with adequate cover to afford elk security during the general big game hunting season, so areas failing to meet this criteria were also removed, leaving patches that were distant enough from open roads, were large enough to meet the minimum criteria, and had adequate cover to provide elk security habitat (*Hillis et al. 1991*). Factors considered in the analysis include the amount of security habitat available and the level of human access for recreational hunting.

EXISTING ENVIRONMENT

Big Game Winter Range

No mule deer (*DFWP 2004*), elk (*DFWP 1999*), moose (*DFWP 2001*), bighorn sheep (*DFWP 2003b*), or mountain goat (*DFWP 2006*) winter range exists in the project area or cumulative-effects analysis area. White-tailed deer are abundant in both the project area and cumulative-effects analysis area. However, white-tailed deer winter range is somewhat limited on the western half of Swan River State Forest. In the project area, 110 acres of white-tailed deer (*DFWP 1996*) winter range exist in the project area. The white-tailed deer winter range occurs primarily on the valley floor along Swan River. Thus, the remainder of this analysis will only focus on the white-tailed deer winter range.

Approximately 3,606 acres of white-tailed deer (*DFWP 1996*) winter range exist in the cumulative-effects analysis area. Much of this winter range exists on DNRC-managed ownership (47.6 percent), with considerable amounts on Plum Creek lands (30.8 percent) and private ownership (21.0 percent). The winter range is largely concentrated within the lowlands associated with Swan River and, as such, timber harvesting has either been somewhat limited due to the moist nature of some of the areas or was conducted long enough ago that winter range attributes are starting to redevelop in the harvested stands. In the cumulative-effects analysis area, salvaging of scattered individual trees with the Low Wood Sanitation Project are having negligible effects to the big game winter range since these trees have already died or are nearly dead and not providing winter-range attributes. Across all ownerships, past timber-harvesting activities, human development, and road construction in the white-tailed deer winter range likely lowered the carrying capacity on this winter range. However, given the limited amounts of winter range spread across several ownerships, the general location on the landscape, and the availability of extensive winter range elsewhere in Swan Valley, the effect of these changes are likely negligible to wintering big game. Evidence of winter use by deer was noted during field reviews.

Elk Security Habitat

Within the project area, approximately 4,505 acres are part of a larger contiguous patch of security habitat that exists in the cumulative-effects analysis area. Additionally, hiding cover, which is inherently a component of elk security habitat, is abundant in the project area; however, approximately 198 acres in the project area do not currently meet the cover requirements. Moderate levels of hunter access exist in the project area with a couple of open roads and considerable nonmotorized access on closed roads.

In the cumulative-effects analysis area, a 17,778-acre forested patch meets the distance, cover, and size requirements of elk security across ownerships in the Porcupine Woodward Grizzly Bear Subunit. This amount of security habitat (47.3 percent of the subunit) exceeds the 30-percent minimum threshold established by *Hillis et al. (1991)*. Additionally, appreciable amounts of hiding cover exist in the cumulative-effects analysis area; however, approximately 4,895 acres in the cumulative-effects analysis area do not currently meet the cover requirements. Hunter access in the cumulative-effects analysis area is relatively unlimited, with several open roads and considerable nonmotorized access on closed roads. No other DNRC salvage/sanitation projects or proposed precommercial thinning activities would be expected to alter elk security cover. Other SVGBCA cooperators (USFS and Plum Creek) have considerable acreage in the Porcupine Woodward Grizzly Bear Subunit used for the cumulative-effects analysis area (*TABLE W-1 PORCUPINE WOODWARD OWNERSHIP*). No activities are proposed on USFS lands that would alter elk security habitats. Plum Creek has lands in the subunit, and any harvesting that may occur on their lands could affect elk security habitat; however, no specific plans exist, so this will only be included qualitatively. Evidence of nonwinter use by elk was noted throughout the project area during field reviews.

ENVIRONMENTAL EFFECTS

- ***Direct and Indirect Effects of No-Action Alternative A to Big Game***

Big Game Winter Range

No additional disturbance or displacement would be anticipated in the project area. No changes in white-tailed deer habitats would be expected during the short-term. Continued use of the project area by wintering white-tailed deer would be anticipated. No direct or indirect effects to big game or big game winter range in the project area would be anticipated since:

1) subtle changes in thermal cover due to mortality and successional advances increasing canopy densities would be anticipated;
2) the amount of mature forested habitats on the winter range would not change appreciably; and
3) the levels of human disturbance would remain similar.

Elk Security Habitat

No changes in elk security cover would be expected. Existing cover would continue to contribute to security habitat. Timber stands would continue advancing to climax plant species. No alterations in cover would occur that would increase elk vulnerability during the hunting season. No changes would be anticipated in disturbance, potential mortality due to hunting, or human access. Thus, no direct or indirect effects to elk security habitat in the project area would be anticipated since:

1) no changes to existing elk security habitat would be anticipated and continued maturation of forest cover would improve elk security habitats;
2) the level of human access would remain similar; and
3) no appreciable changes to big game survival would be anticipated.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Big Game***

Big Game Winter Range

Negligible displacement of wintering white-tailed deer would be expected since no harvesting in the 110 acres of winter range would occur; however, all action alternatives have similar amounts of land to be harvested within 0.5 miles of the winter range (Action Alternative B has 186 acres, Action Alternative C has 179 acres, and Action Alternative D has133 acres) that would be harvested, which could provide some disturbance to wintering white-tailed deer should these units be harvested during the winter. Minor positive, short-term benefits would be anticipated as deer would concentrate feeding activity on felled tree tops, limbs, and slash piles during nighttime and quiet periods when logging operations are shut down, should these areas be harvested during the winter. These positive benefits would be expected to partially offset any disturbance effects to these wintering deer. Minor amounts of winter range would be lost with the proposed gravel pit development on 22 acres (20 percent of the winter range in the project area) and, due to the nature of these activities, recovery of habitat attributes would not occur. Since gravel pit excavation and hauling would not occur during the winter period, no disturbance to wintering white-tailed deer would be expected. Continued use of the project area by wintering white-tailed deer would be anticipated. Thus, direct and indirect effects would be minor negative effects that would affect big game in the project area for the foreseeable future under all alternatives since:

1) the amount of winter range that would be removed is small and exists largely in lower-quality, pole-sized stands;
2) most of the forested cover in the project area would be retained;
3) no disturbance would be expected during the winter; and
4) the levels of human disturbance would remain similar.

Elk Security Habitat

No changes in open roads or motorized access would occur. During all phases of the project, any roads opened with project activities would be restricted to the general public and closed after the completion of project activities. Proposed new roads would be restricted to the general public, but could facilitate nonmotorized access during the hunting season using mountain bikes, horses, and/or foot travel. Action Alternative B constructs the highest amount of roads that could facilitate this increased human presence, while Action Alternative C constructs the fewest miles of new road (*TABLE W-19 – PROJECT AREA ELK SECURITY PARAMETERS*). Additionally, provisions in the SVGBCA prohibit contractors from carrying firearms while on duty, which would effectively further

TABLE W-19 – PROJECT AREA ELK-SECURITY PARAMETERS. Proposed amounts of elk security habitat removed, amount of elk security habitat retained, and amount of linear miles of permanent, restricted road construction expected under each alternative in the project area.

PARAMETER	ALTERNATIVES			
	A	B	C	D
Acres elk security habitat altered (percent of project area security habitat)	0 (0)	216 (4.8)	142 (3.2)	132 (2.9)
Acres elk security habitat removed (percent of project area security habitat)	0 (0)	1,006 (22.3)	1,106 (24.6)	901 (20.0)
Acres of elk security habitat (percent of project area security habitat)	4,505 (100)	3,499 (77.7)	3,399 (75.4)	3,604 (80.0)
Linear miles of new permanent, restricted road	0	14.0	9.5	11.2
Linear miles of permanent restricted road (percent increase)	35.4 (0)	49.4 (39.5)	44.9 (26.8)	46.6 (31.6)

reduce access to some of these elk security habitats by people who could harvest elk.

In the project area, proposed units with seedtree and shelterwood treatments would likely be too open to provide elk security, while those areas receiving variable-thin treatments would likely continue to provide some cover that could benefit elk during the hunting season (*TABLE W-19 – PROJECT AREA ELK SECURITY PARAMETERS*). Under the action alternatives, a range of 132 to 216 acres of security habitat would be altered and 901 to 1,106 acres of security habitat would be removed for 20 to 30 years until trees and shrubs provide adequate cover for elk, with the greatest reduction being associated with Action Alternative C, and the smallest reduction being associated with Action Alternative D. Reductions in suitable cover that contribute to elk security habitat would be additive to past harvesting in the project area (approximately 198 acres), and that does not meet the cover requirement for elk security habitat. The proposed gravel pit would not alter elk security habitats. Layout within the proposed units to meet the SVGBCA requirement of 600 feet to cover (see *HIDING COVER* under *GRIZZLY BEAR* in this analysis) would provide some benefits to elk within the proposed regeneration units by requiring a specified distribution of hiding cover. Overall, increased sight distances and the reduction in hiding cover may increase elk vulnerability risk in the project area. Action Alternative D, which builds an intermediate amount of new roads, reduces the least amount of elk security habitat and would be expected to have proportionally fewer effects to elk security; meanwhile, Action Alternatives B and C would both have slightly greater effects to elk security due to the increased amounts of hiding cover affected and/or the higher amounts of new road construction. Collectively, minor adverse effects to elk security habitat would be anticipated that would affect elk vulnerability risk in the project area for 20 to 30 years since:

1) no changes in open roads or motorized access for the general public would be anticipated that would increase hunter access;
2) minor to moderate increases in nonmotorized access could increase hunter access on 9.5 to 14 miles of new restricted roads, depending on alternative;
3) sizeable amounts of elk security habitat would be affected (22.9 to 27.7 percent, depending on alternative); and
4) potentially, big game survival would have slight decreases.

- ***Cumulative Effects of No-Action Alternative A to Big Game***

Big Game Winter Range

No further changes in white-tailed deer habitats would be expected during the short term. Continued use of the project area by wintering white-tailed deer would be anticipated. Human disturbance levels across the winter range would be anticipated to continue at similar levels. Thus, negligible beneficial cumulative effects to big game and big game winter range would be anticipated that would benefit big game in the cumulative-effects analysis area since:

1) subtle changes in thermal cover due to mortality and successional advances increasing canopy densities would be anticipated over time;
2) the amount of mature forested habitats on the winter range would not change; and
3) the levels of human disturbance would remain similar.

Elk Security Habitat

Approximately 47.3 percent of the cumulative-effects analysis area (*TABLE W-20 –ELK SECURITY PARAMETERS - CUMMULATIVE-EFFECTS ANALYSIS AREA*) would continue providing elk security habitat, which would exceed the 30-percent minimum threshold recommended by *Hillis et al. (1991)*. Continued maturation in previously harvested stands on all ownerships in the cumulative-effects analysis area would improve hiding cover within those older units. No other changes in disturbance and potential mortality due to hunting would be anticipated. Thus, minor positive cumulative effects to elk security would be anticipated that would benefit elk since:

1) no changes in open roads, motorized access, or human access would be anticipated;
2) no further reductions in elk security habitat would occur; and
3) modest levels of security habitat and hiding cover would persist within the cumulative-effects analysis area.

- ***Cumulative Effects to Big Game Common to Action Alternatives B, C, and D***

Big Game Winter Range

Thermal cover and snow intercept capabilities would be removed from 22 acres of the winter range (0.6 percent of the cumulative-effects analysis area winter range), which would be additive to the past reductions associated with timber harvesting and human development that has occurred on the winter range. No appreciable changes in human disturbance levels across the winter range would be anticipated. Harvesting of 133

TABLE W-20 – ELK SECURITY PARAMETERS - CUMMULATIVE-EFFECTS ANALYSIS AREA. Amount of elk security habitat removed and modified, amount of retained elk security habitat, and percentage of the entire subunit providing elk security habitats.

PARAMETER	ALTERNATIVES			
	A	B	C	D
Acres elk security habitat altered (percent of subunit elk security habitat)	0 (0)	216 (1.2)	142 (0.8)	132 (0.7)
Acres elk security habitat removed (percent of subunit elk security habitat)	0 (0)	1,006 (5.7)	1,106 (6.2)	901 (5.1)
Acres of elk security habitat (percent of subunit elk security habitat)	17,778 (100)	16,772 (94.3)	16,672 (93.8)	16,877 (94.9)
Percent of the cumulative effects analysis area providing elk security habitat	47.3	44.6	44.3	44.9
Linear miles of permanent, restricted road improved	0	62.9	41.6	60.4

to 186 acres within 0.5 miles of the winter range could provide slight disturbance to wintering deer, but would also provide a short-term food source that would partially offset the additional disturbance effects. Ongoing salvage/sanitation associated with the Low Wood Sanitation Project could disturb individuals on the winter range, but minimal change to winter-range attributes would be anticipated given the mortality that is occurring or has occurred in the trees being salvaged. No other DNRC projects would occur in the winter range. Plum Creek is the other large landowner with winter range in the cumulative-effects analysis area, and much of their lands appear to already have had winter-range attributes reduced through past harvesting or exist in lowlands where timber harvesting is less feasible. Any plans for future harvesting on Plum Creek and small private ownerships within the winter range are unknown, but could continue to reduce winter range attributes. Thus, minor adverse cumulative effects to deer would be anticipated under all alternatives considering:

1) the scale of the area being considered for treatment would be rather small;
2) considerable amounts of the white-tailed deer winter range would remain untreated;
3) the behavioral adaptability of white-tailed deer;
4) the semipermanent nature of the habitat loss associated with the gravel pit; and
5) the levels of human disturbance would remain similar.

Elk Security Habitat

No changes would be anticipated in open roads or motorized access for the general public that would influence elk vulnerability, but project-level alterations of cover could reduce elk-security habitat. Depending upon alternative, between 901 and 1,106 acres of elk security habitats in the project area would be removed with the proposed activities, with the greatest reductions being associated with Action Alternative C, and the smallest reduction being associated with Action Alternative D. Increased sight distances could reduce elk survival in the project area and proposed road construction could facilitate an increase in nonmotorized traffic. Motorized access in the cumulative-effects analysis area is relatively limited, but nonmotorized access via closed roads is relatively high. Improvements to permanent, restricted roads could facilitate slight increases in nonmotorized uses. Portions of the cumulative-effects analysis area have been harvested, reducing hiding cover and elk security habitat *(TABLE W-20 – ELK SECURITY PARAMETERS - CUMMULATIVE-EFFECTS ANALYSIS AREA)*. Ongoing salvage/sanitation projects, recently completed salvage/ sanitation projects, and proposed precommercial thinning projects would not affect elk security habitats appreciably. No projects are planned on USFS lands that would alter elk security habitats. Plum Creek has lands in the subunit, and any harvesting that may occur on their lands could reduce cover attributes; however, no changes in open roads or motorized human access would be expected. Suitable cover that may contribute to elk security habitat would be reduced, which would be additive to past harvesting on approximately 4,895 acres in the recent past plus any ongoing harvesting across all ownerships in the cumulative-effects analysis area. Under all action alternatives, a range of 44.3 to 44.9 percent of the cumulative-effects analysis area would be providing elk security habitat (*TABLE W-20 – ELK SECURITY PARAMETERS - CUMMULATIVE-EFFECTS ANALYSIS AREA*), which would exceed the 30-percent minimum threshold recommended by *Hillis et al. (1991)*. Continued maturation in previously harvested stands in the cumulative-effects analysis area would improve hiding cover in those older units and partially offset these current losses. All SVGBCA cooperators would be required to lay out timber sale projects so that no point is more than 600 feet to cover, which would have some benefits to big game by providing some cover. In general, minor effects to elk security cover or survival at the cumulative-effects analysis area level would be expected under all action alternatives; however, since Action Alternative D retains the largest amount of hiding cover and would construct an intermediate amount of permanent road, slightly fewer effects would be anticipated than with Action Alternatives B and C. Thus, minor adverse cumulative effects to elk security would be anticipated that would affect elk using the cumulative-effects analysis area for 10 to 30 years since:

1) no changes in open roads or motorized access for the general public would be expected;
2) changes to nonmotorized access would be minor;
3) sizeable amounts of amounts of elk security habitat would be affected; and
4) the modest levels of security habitat and hiding cover would persist in the cumulative-effects analysis area.

GEOLOGY AND SOILS ANALYSIS

INTRODUCTION

The following document discloses the potential impacts to soils resources within the project area as defined in *CHAPTER 1 – PURPOSE AND NEED* for each of the 4 alternatives outlined in *CHAPTER II – ALTERNATIVES*. Each action alternative varies by the amount of new road construction, types of logging systems and how much each is used, and silvicultural prescriptions. All of the variables mentioned above have been shown to result in a range of impacts to soil resources in both magnitude and spatial extent (*DNRC 2005*). The following will analyze each alternative with respect to issues and concerns that were raised internally at DNRC and through public comment, public field tours, and public meetings as described in *ISSUES STUDIED IN DETAIL* under *SCOPE OF THIS EIS* in *CHAPTER 1.*

ISSUES AND MEASUREMENT CRITERIA

The issue statements listed below summarize both internal and public concerns that will be analyzed in this analysis.

- Traditional ground-based harvesting operations have the potential to compact and displace surface soils, which reduces hydrologic function, macroporosity, and soil function.
- Harvesting operations have the potential to increase erosion of productive surface soils offsite.
- Harvesting activities associated with the proposed actions may cumulatively affect long-term soil productivity.
- Activities associated with the proposed actions, such as timber harvesting and road construction, have the potential to affect slope stability through increased water yields and road surface drainage concentration, resulting in the exceedence of resisting forces.
- The removal of large volumes of both coarse and fine woody material through timber harvesting reduces the amount of organic matter and nutrients available for nutrient cycling, possibly affecting the long-term productivity of the site.

The measurement criteria that will be used to assess the direct, indirect, and cumulative effects regarding the issues listed above are displayed in *TABLE S-1 -MEASUREMENT CRITERIA*.

Field review, professionally published soils surveys and landscape information, and internal DNRC monitoring data will assist and complement data collection of measurement criteria. The methods for how this information will be used to disclose impacts can be reviewed in the *ANALYSIS METHODS* of this analysis with technical details further described in a report in the project file (*DNRC 2008*).

ANALYSIS AREAS

The project area consists of 6,295 acres located on the west side of Swan River State Forest (*FIGURE S-1 – WHITE PORCUPINE PROJECT AREA AND SOIL MAP UNITS*). While each alternative varies by spatial extent and the type and amount of logging systems used, the common analysis area for direct and indirect effects for soil physical properties, nutrient cycling, and site productivity will include harvest units, landings, new and temporary road construction, and, potentially, developed gravel sources. The proposed action alternatives have the potential to affect slope

FIGURE S-1 – WHITE PORCUPINE PROJECT AREA AND SOIL MAP UNITS

WHITETAIL PORCUPINE PROJECT AREA - SWAN RIVER STATE FOREST
SPATIAL EXTENT OF SOIL MAP UNITS

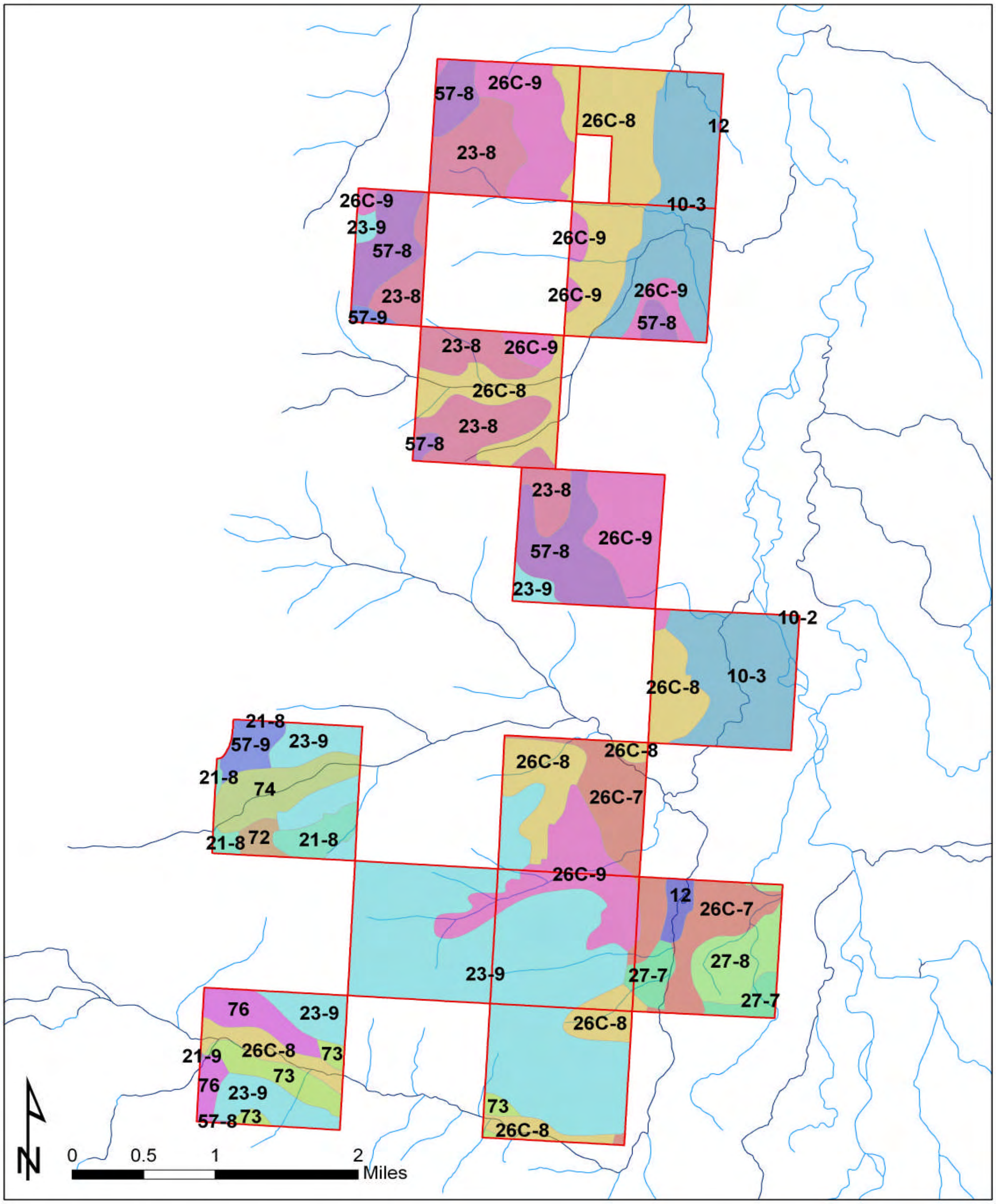


TABLE S-1 - MEASUREMENT CRITERIA

GENERALIZED ISSUE	MEASUREMENT CRITERIA	UNITS
Slope stability	Length of existing and proposed new road construction on potentially unstable landtypes.	Miles
Soil physical properties	Bulk density, displacement, and compaction (*Howes et al. 1983*)	g/cm^3, % of area[1]
Erosion	Magnitude of current chronic upland erosional sites	Number of sites
Site nutrients	Volume of coarse and fine woody debris	Tons/acre
Long-term productivity	Amount of acres proposed for reentry, coarse and fine woody debris	Acres

[1] *Grams per cubic centimeter, percent of area.*

stability and erosion on different spatial scales than the analysis area described above. Recognizing this, the analysis areas for slope stability and erosion will be the gross project area.

Cumulative effects by definition are the collective impacts on the human environment of the proposed action(s) when considered in conjunction with other past, present, and future actions related to the proposed action by location or generic type. For an impact to soil resources to be cumulative they must overlap a least twice in both time and space. Considering this constraint, the cumulative-effects analysis area for all proposed alternatives will be the same as that described for the direct and indirect impacts, except for issues relating to slope stability and erosion, in which case the project area will be the unit of analysis.

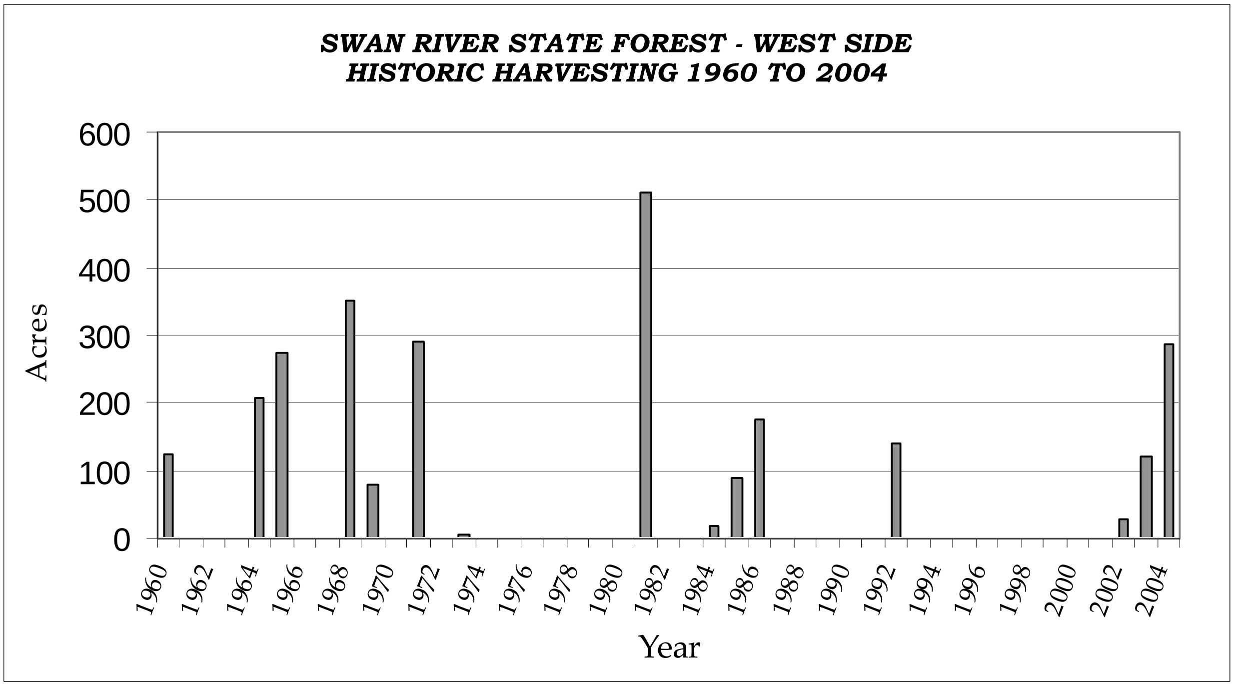
ANALYSIS METHODS

It has been shown through DNRC soil monitoring *(DNRC 2005*) that past performance in timber sale contract administration, BMP design and implementation, and harvest design are good indicators of expected future results regarding impacts to soil resources. The following soil analysis was designed around this assumption, which has been validated through 20 years of quantitative soil monitoring conducted by DNRC.

Three periods of major historic harvesting have occurred on the west side of Swan River State Forest. These periods include the mid- to late 1960s, early 1980s, and most recently with the South Woodward Timber Sale that was completed in 2004. Varying amounts of acres were harvested in the project area during these periods and range from 834 acres from 1964 to1968, 511 acres in 1981, and 438 acres since 2002. A timeline of this harvest can be found below in *FIGURE S-2 – HISTORIC HARVESTING*.

Historic harvest units from these 3 time periods were analyzed in GIS to find harvest units from previous projects that best represented the range of site types found in the alternatives for the proposed actions. Historic harvest units were primarily selected by habitat type (*Intermountain Forest and Range Experiment Station [Ogden Utah] 1977*) and soil map unit (*Martinson 1999*). Selected sites also represented a range of siviculture treatments including clearcut, seedtree, overstory removal, and shelterwood prescriptions. This coarse-filter GIS exercise helped focus data collection to sites that would reveal the most information

FIGURE S-2 – HISTORIC HARVESTING



concerning site response to forest management and the temporal magnitude of expected impacts to soil resources.

Selected historic harvest units were sampled in the summer of 2007. Both random and purposefully placed transects were used to collect information on soil displacement, compaction, erosion, puddling, and deposition (*Howes et al. 1983*). Also collected along these transects were 54 bulk-density samples Both coarse and fine woody material were also measured (*Brown 1974*) for use as a surrogate in assessing nutrient pools and historic nutrient management on the site.

Previously unentered stands on soil map units within the project area were also sampled to obtain background bulk-density values and levels of coarse and fine woody material to compare managed stands against. These data will also be used to help frame the existing environment of unmanaged stands in the project area.

From this intensive sampling and data-collection effort, information on a range of harvest prescriptions on various habitat types and soils from 3 separate time frames could be used to infer potential impacts to soils resources resulting from implementing the proposed action. These data will also be used in concert with DNRC soil-monitoring data on other projects completed on similar ash-capped soil types as those found in the project area. For further inquiries regarding method specifics, such as lab analysis, sampling techniques, and data analysis, refer to the methods report in the project file (*DNRC 2008*).

RELEVANT AGREEMENTS, LAWS, PLANS, RULES, AND REGULATIONS

Developed in 1996, the SFLMP is a programmatic plan that outlines the approach and philosophy guiding land-management activities on forested school trust lands throughout the State of Montana (*DNRC 1996*). Within this plan, detrimental soil disturbance is defined and recommends that projects implemented by DNRC should strive to maintain the long-term soil productivity of a site by limiting detrimental soil impacts to 15 percent or less of a harvest unit and retaining adequate levels of both coarse and fine woody material to facilitate nutrient retention and cycling.

To accomplish these goals and objectives, contract stipulations and site specific BMPs are developed to provide protection for soil resources in a project area. The *Forest Management Rules [ARM 36.11.422 (2) (2) (a)]* state that appropriate BMPs shall be determined during project design and incorporated into implementation. *ARM 36.11.414* mandates that adequate coarse woody debris shall be left on site to facilitate nutrient conservation and cycling. To ensure that incorporated BMPs are implemented and site productivity is maintained, specific requirements are incorporated into the DNRC timber sale contracts. The following are general BMPs and mitigations that would be incorporated into the proposed action to ensure adequate soil protection and long-term productivity of the site.

- Limit equipment operations to periods when soils are relatively dry, (less than 20-percent soil moisture), frozen, or snow-covered (12 inches packed or 18 inches unconsolidated) to minimize soil compaction and rutting and maintain drainage features.
- Ground-based logging equipment (tractors, skidders, and mechanical harvesters) is limited to slopes of less than 40 percent on ridges and convex slopes, and to 35 percent or less on concave slopes without winter conditions.
- The Forest Officer shall approve a plan for felling, yarding, and landing placement in each harvest unit prior to the start of operations in that unit. The locations and spacings of skid trails and landings shall be designated and approved by the Forest Officer prior to construction.
- Levels of coarse and fine woody material will be retained on site as prescribed by the Forest Officer and recommended by the project soil scientist using the best available science (*Graham et al. 1994*).

These general BMPs, along with site-specific mitigations designed during contract development, have been monitored for effectiveness by DNRC since 1988 and have repeatedly been shown to be an effective measure to achieve objectives described in the SFLMP (*DNRC 2005*).

The construction of the road network necessary to complete objectives under all action alternatives would require a large gravel and aggregate source for road surfacing and maintenance. These activities are permitted through the Industrial and Energy Minerals Bureau of DEQ, and would require an Open Cut Mining Permit to be in compliance with the *Open Cut Mining Act (82-4-401 et seq., MCA)*. This permit is required for all operations that remove over 10,000 cubic yards of material and overburden from a site. An air quality permit from DEQ would also be required for crushing and processing the aggregate on-site.

EXISTING ENVIRONMENT

This section describes the current conditions and trends of soil resources within the project area. These conditions, with respect to soils and geology, will serve as the baseline in which environmental effects of the alternatives will be compared.

GEOLOGY

The geology in the project area is dominated by the middle to upper stratigraphic sections of the Ravalli group and conformably above this sequence, the Piegan group, both Precambrian in age. The only formation within the Ravalli group exposed in the project area is the poorly exposed Spokane formation. This formation is thinly bedded to laminated, red to maroon-gray, coarse-grained argillite and siltites (*MBMG 2004*). The Spokane formation is relatively resistant to weathering and is a fair nutrient source for soils (*Johnson 2007*).

Basal sections of the Piegan group include the Helena Formation, which dominates outcrops in higher elevations of the project area. This formation is characterized by cyclic bedding, forming bands of gray to black argillite or gray dolomitic siltite that weathers to a tan color, alternating with dense limestone that weathers to orange-brown (*MBMG 2004*). Moderately resistant to weathering, the mineralogy of this formation makes for a poor source of soil nutrients required for tree growth (*Johnson, 2007*).

During the Laramide orogeny, a period of mountain building in western North America, which started in the late Cretaceous 70 to 80 million years ago and ended 35 to 55 million years ago, Swan Valley was formed through block faulting along the Swan fault on the eastern margins of the valley. This period of uplift is responsible for the dramatic relief observed today along the Swan front and more gradual grades of the headwall dipping to the east in the project area.

LANDFORMS AND SOILS

The landforms and valley morphology observed today in Swan Valley are largely a result of glacial and fluvial processes working in concert to erode, transport, and redeposit sediment. Two large-scale continental glacial advances and recessions have helped to transport the massive glacial till deposits we observe today in the form of moraines, eskers, outwash plains, and numerous other glacial features. Since the end of the Pinedale Glaciation, approximately 15,000 years ago, massive alpine glaciers had advanced and receded through Swan Valley, ultimately resulting in the numerous lakes and glacial outwash deposits at canyon mouths along the Swan and Mission mountains. In the project area, the landforms consist of concave, convex, and planer hillslopes of various grades. The drainage network within the project is rather dendritic and well developed when compared to the valley bottoms, which suggests a much older surface and more developed soils.

Eleven soil map units exist in the project area. Map units, along with the landform each unit is typically associated with, are presented below in *TABLE S-2 – SOIL MAP UNITS AND ATTRIBUTES*. Management implications for erosion and sediment-delivery efficiency, along with compaction and displacement hazards, are also listed below in *TABLE S-2 – SOIL MAP UNITS AND ATTRIBUTES*. A map depicting the spatial extent of soil map units within the

TABLE S-2 – SOIL MAP UNITS AND ATTRIBUTES

MAP UNIT	ACTION ALTERNATIVE HARVEST UNITS/NEW ROAD ACRES			MAP UNIT NAME	LANDFORM	EROSION AND SEDIMENT DELIVERY EFFICIENCY	COMPACTION/ DISPLACEMENT HAZARD
	B	C	D				
72	0/0	0/0	16.7/0	Cirqueland-entic Cryandepts complex, very steep	Unit is on headwalls and alpine ridges. Slopes are 60 to 90 percent on crique headwalls on north- facing aspects. No surface drainage pattern.	Slight, typically delineated too far from drainage channels.	Low/moderate
73	6.7/0	0/0	0/0	Andic Cryochrepts-Andpetic Cryoboralfs association, glacial through walls	Steep 60 to 90 percent slopes on glacial trough walls contain valley walls of U-shaped glacial valleys. Straight slopes on the upper half and concave slopes on lower half. Drainage pattern is parallel.	Upper slopes are low; lower slopes are high.	Low/moderate
74	66.8/6.1	0/0	67.5/6.1	Ochrepts, very steep	On stream breaklands, which conist of narrow V-shaped valley slopes along major streams. These are barren, rapidly eroding soils where streams are actively undercutting slopes.	High	Low/moderate
10-3	32.8/0.6	159.5/1.9	20.4/0	Aquepts, stream bottoms	Dominant slopes have gradients of 0 to 5 percent. Located in depressions on flood plains and often shallow ponds. Subject to flooding during spring snowmelt and have highly fluctuating water tables.	Severe, but SMZ laws would prohibit most operations.	High/moderate
21-8	18.9/1.5	0/0	65.1/3.5	Andic Cryochrepts-Enyic Cryandepts-Rock Outcrop Complex, cirque Basins	Slopes from 20 to 40 percent. Cirque basins are rolling to hilly basins at the head of U-shaped valleys. Drainage pattern is dendritic and has widely spaced low-order drainages.	Moderate erosion hazard. Low sediment delivery efficiency.	Moderate/ moderate
23-8	252.5/20.7	402.2/21.6	221.8/17.5	Andeptic Cryoboralfs-Andic Cryochrepts complex, hilly.	Glaciated mountain slopes and ridges with dominant slopes from 20 to 60 percent. Typically mantled with glacial tills. Drainage is dentritic and widely spaced.	Skid trails are moderate. Moderate sediment delivery efficiency.	High/high
23-9	348.9/25.4	39.1/1.3	133.5/10.5	Andeptic Cryoboralfs – Andic Cryochrepts complex, steep.	Dominant steep slopes between 40 and 60 percent. Glaciated mountain slopes and ridges mantled with glacial tills.	Skid trails are moderate. Moderate sediment delivery efficiency.	Moderate/ moderate

TABLE S-2 – SOIL MAP UNITS AND ATTRIBUTES (continued)

MAP UNIT	ACTION ALTERNATIVE HARVEST UNITS/NEW ROAD ACRES			MAP UNIT NAME	LANDFORM	EROSION AND SEDIMENT DELIVERY EFFICIENCY	COMPACTION/ DISPLACEMENT HAZARD
	B	C	D				
26C-8	253.7/3.6	406.4/9.4	245.9/7.8	Andeptic Cryoboralfs, silty till substratum, hilly.	Glaciated mountain slopes and ridges with dominant slopes from 20 to 60 percent. Typically mantled with glacial tills. Drainage is dentritic and widely spaced.	Moderate erosion hazard. Moderate sediment delivery efficiency.	High/high
26C-9	336.6/7.4	355.8/6.2	239.0/4.9	Andeptic Cryoboralfs, silty till substratum, steep.	Glaciated mountain slopes and ridges with dominant slopes from 40 to 60 percent. Typically mantled with glacial tills. Drainage is dentritic and widely spaced.	Moderate erosion hazard. High sediment delivery efficiency.	Moderate/high
57-8	114.3/16.8	196.0/16.8	100.5/12.9	Andic Cryochrepts, glaciated mountain ridges.	Dominant slopes have gradients of 20 to 40 percent. Glaciated mountain ridges have smooth, rounded convex ridgetops.	Moderate erosion hazard. Low sediment delivery efficiency.	High/moderate
57-9	87.8/2.9	3.9/0.2	76.0/2.8	Andic Cryochrepts, glaciated mountain slopes.	Dominant slopes have gradients of 40 to 60 percent. Galciated mountain slopes have thin glacial till in places. Drainage pattern is dentritic and widely spaced.	Moderate erosion hazard. Moderate sediment delivery efficiency.	Moderate/ Moderate
Totals	1,519.0/84.9	1,563.0/57.4	1,186.4/65.9				

project area can be found at the end of this document in *FIGURE S-1 – WHITE PORCUPINE PROJECT AREA AND SOIL MAP UNITS* (*Martinson 1999*).

The displacement and compaction hazard ratings are derived from professional judgment, landform association, and physical soil properties such as textural classification, coarse fragments, and plasticity index. The hazard is described as low, moderate, and high. A low hazard indicates that the terrain and soil characteristics lend themselves to a low probability of an impact assuming all BMPs are implemented. A moderate hazard indicates a 50/50 chance of impacts assuming BMPs are implemented. A high hazard indicates that terrain and soil properties are such that impacts are likely to occur with the areal extent of impacts mitigated by BMPs such as harvest design and skid trail location and spacing.

Erosion and sediment delivery efficiency is based on the slope and soil erosion K factor. The hazard is described as slight, moderate, high, or severe (*Hansen 2004*):

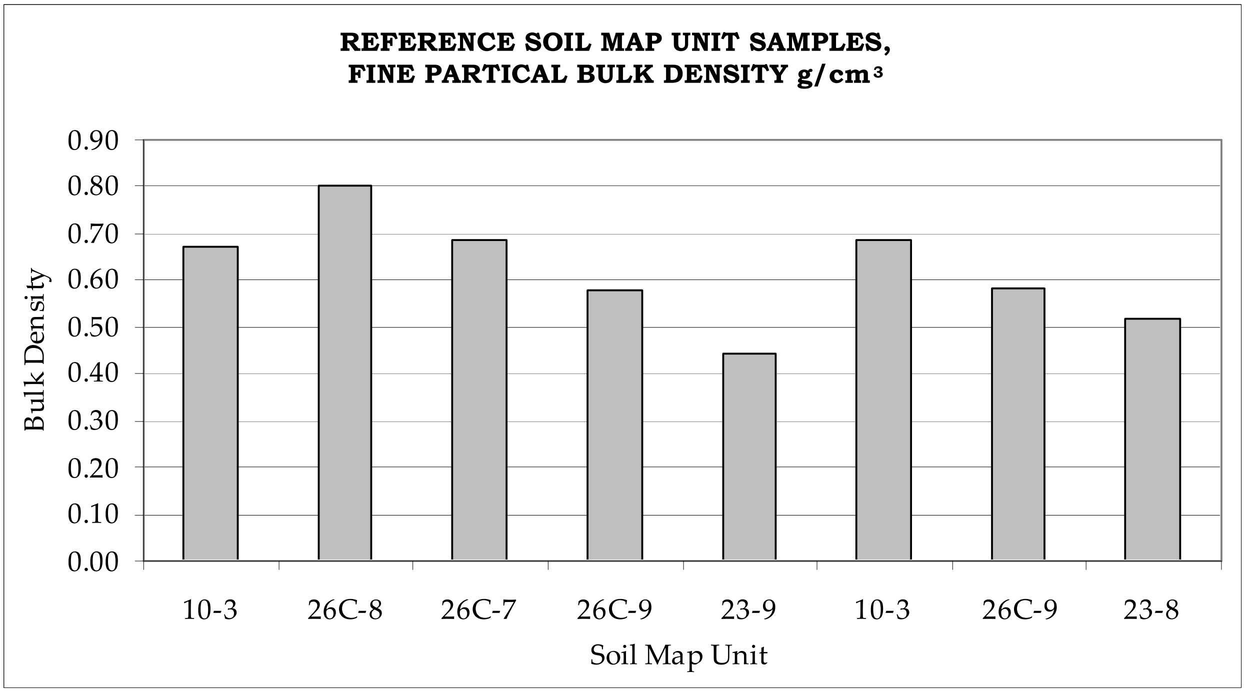
- a rating of slight indicates that erosion is unlikely under ordinary climatic conditions;
- a rating of moderate indicates that some erosion is likely and that erosion-control measures may be needed;
- a rating of high indicates that erosion is very likely and erosion-control measures, including revegetation of bare areas, are advised; and
- a rating of severe indicates that substantial erosion is expected, loss of soil productivity and off-site damage are likely, and erosion–control measures are costly and generally impractical (*Hansen, 2004*).

Sediment delivery efficiency refers primarily to the slope of the landform where the map unit is located and the proximity of the map unit with respect to water features. Soil map units typically associated with upland environments or on ridges are typically inefficient at transporting sediment to water features when compared to those associated with riparian or streambank landforms.

In general, the soils within the project area adjacent to the valley floor include deep alluvial and glacial deposits on low grades. Wetland or hydric soils have been identified adjacent to kettle lakes, areas consistently inundated by flood waters, and areas influenced by beaver activity. Shallow bedrock and residual soils with high rock content are found on glacial-scoured ridges, while valley hillslopes have moderate to deep glacial till deposits with cobble silt loam subsoils.

A common feature to all soil map units within the project area is the influence of volcanic ash. Volcanic ash from eruptions along the Pacific Northwest Cascade Range has significantly influenced forest soil productivity in the Inland Northwest (*Mullineaux 1996; Shipley 1983*) and particularly the project area. Soils influenced by volcanic ash have lower bulk densities, higher porosities, high cation exchange capacity and higher water infiltration and retention (*Shoji, 1993*), as well as reduced stress to plant communities during droughty conditions. *FIGURE S-3 – REFERENCE SOIL MAP UNIT SAMPLES* shows soil bulk density values from referenced unentered forest stands growing on numerous soil map units in the project area. Very low bulk-

FIGURE S3 – REFERENCE SOIL MAP UNIT SAMPLES



density values are consistent with ash-influenced surface soils. Ash thickness in the project area has been observed to range from a few inches at higher elevations to more then 16 inches in sheltered, middle-elevation sites. The productivity of Swan Valley is closely linked to the ash-influenced soils; properly managed, Andic soils similar to those found in the project area, can be some of the most productive on earth.

SLOPE STABILITY

Slope stability is the ability of material on a slope to remain in equilibrium (stable) and, therefore, represents some balance between driving forces (shear stress) and resisting forces (shear strength). Many variables, both natural and/or human caused, may affect either driving or resisting forces. For a slope to be considered unstable, driving forces and resisting forces must be close to unity. Factors affecting these forces include slope, parent material, vegetation, and precipitation. While landslides and mass movements are a dominant geomorphic agent and landscape-evolution process in certain areas of the country, it is not a commonly observed process in northwestern Montana.

Both the FNF Land System Inventory and DNRC have identified erosive landtypes that can be prone to mass failure. Two of these landtypes exist in the project area and include map units 57-8 and 57-9, which comprise 668 acres of the project area. In the project area, the maximum slope in map unit 57-8 is 60 percent with an average of 25 percent. The angle of repose for this silty loam material has been shown to be around 35 degrees or 60 percent (*Carson, 1972*), supporting field observations that this map unit is stable in a majority of the project area. Map Unit 57-9 is typically found on steep slopes prone to mass failure (less than 60 percent) and comprises 101 acres of the project area. These 101 acres have been identified as sensitive areas where management actions may affect slope equilibrium and the possibility of slope failure if not adequately mitigated.

Only one area has been identified where slope failure has occurred in the project area. Slope failure at this site is attributed to a relatively small, shallow planer failure located on a steep, convex hillslope above a forest road. The failure resulted in the release of fill material from the forest road into a first-order catchment. A first-order catchment is a small basin without defined channel features that does not collect surface or subsurface flow from any other defined drainage feature and is typically less then 10 acres. This was the only slope failure observed during field review of the project area.

HISTORIC HARVEST AND RELATED MANAGEMENT ACTIVITIES

PHYSICAL SOIL PROPERTIES

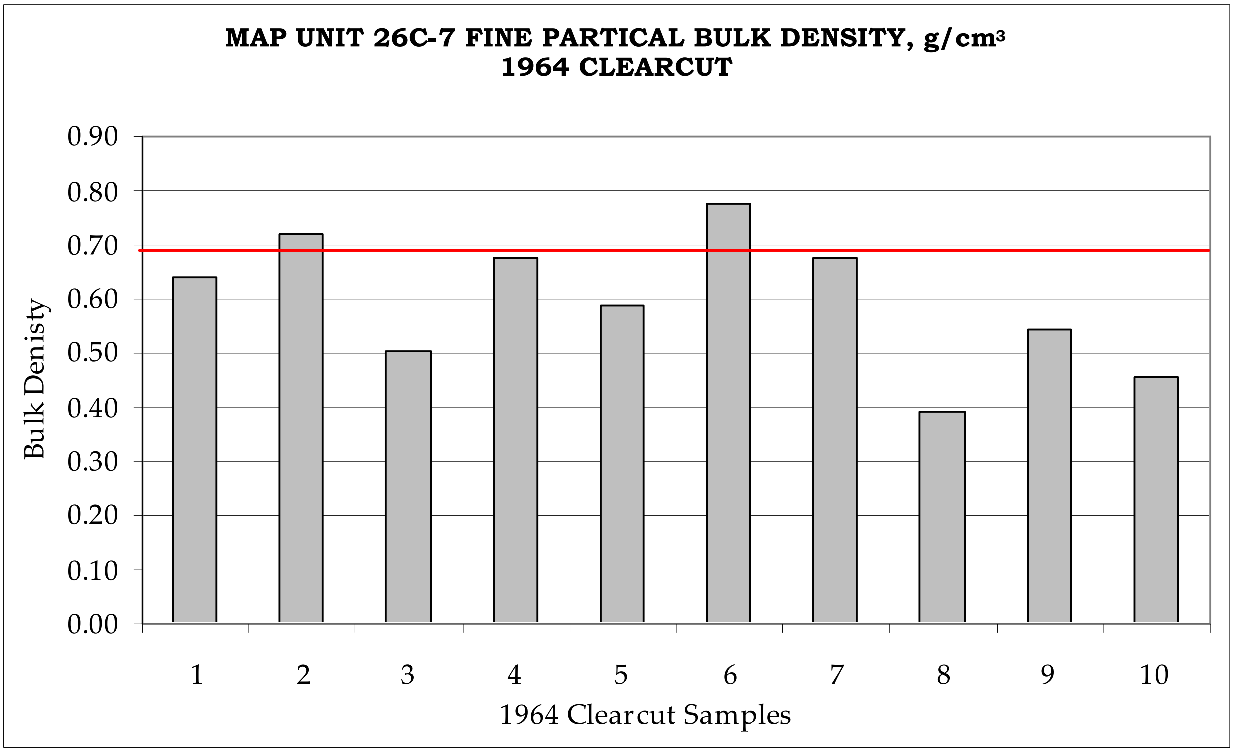
Since the 1920s, Swan River State Forest has been actively managed for timber production. A majority of the timber harvesting in these early periods involved select cutting of only the most merchantable timber. Timber was typically hand-felled and skidded with horses until mechanized equipment was employed. Impacts to soil resources prior to the late 1950s are assumed to be ameliorated except for the most heavily impacted skid trails, which comprise a very low percentage of the project area.

Accurate inventory and recordkeeping from the 1960s to the present enables a more analytical analysis of past soil resource impacts. As previously shown in *FIGURE S-2 – HISTORIC HARVESTING*, 3 distinct and pronounced periods of timber harvesting has occurred on the west side of Swan River State Forest, including the mid- to late 1960s, the early 1980s, and, most recently, sales completed in 2004. Soil samples collected within a historic harvest unit are representative of the stands that were harvested in 1964. Results show no pronounced differences between average bulk-density values when compared to an unentered stand on similar soils. From the results of these data presented below in *FIGURE S-4 – SOIL PHYSICAL PROPERTIES IN A 1964 HARVEST UNIT*, we can infer that past soil-resource impacts have naturally ameliorated in this harvest unit due to the moist climatic conditions found in the project area, long periods of freeze-thaw climatic conditions, and root penetration from ground vegetation and the regenerating stand.

We can further extrapolate these point measurements to the whole harvest unit by examining random transects that were placed throughout the unit to monitor soil disturbance. Using 5 transects and 500 sample points, the level of compaction within this historic harvest unit was estimated at 1.6 percent of the 18.3-acre unit. Furthermore, on average, 4.2 percent of the unit was estimated to be detrimentally impacted by either displacement and/or compaction. No erosion was observed within this historic harvest unit. This information is critical when considering the temporal aspect of soil impacts from implementing the proposed actions of this project and will be referenced later in this document when considering environmental consequences.

A similar methodology was employed on 2 sites that were harvested in 1981 by different sivilcultural prescriptions. The prescription

FIGURE S-4 – SOIL PHYSICAL PROPERTIES IN A 1964 HARVEST UNIT

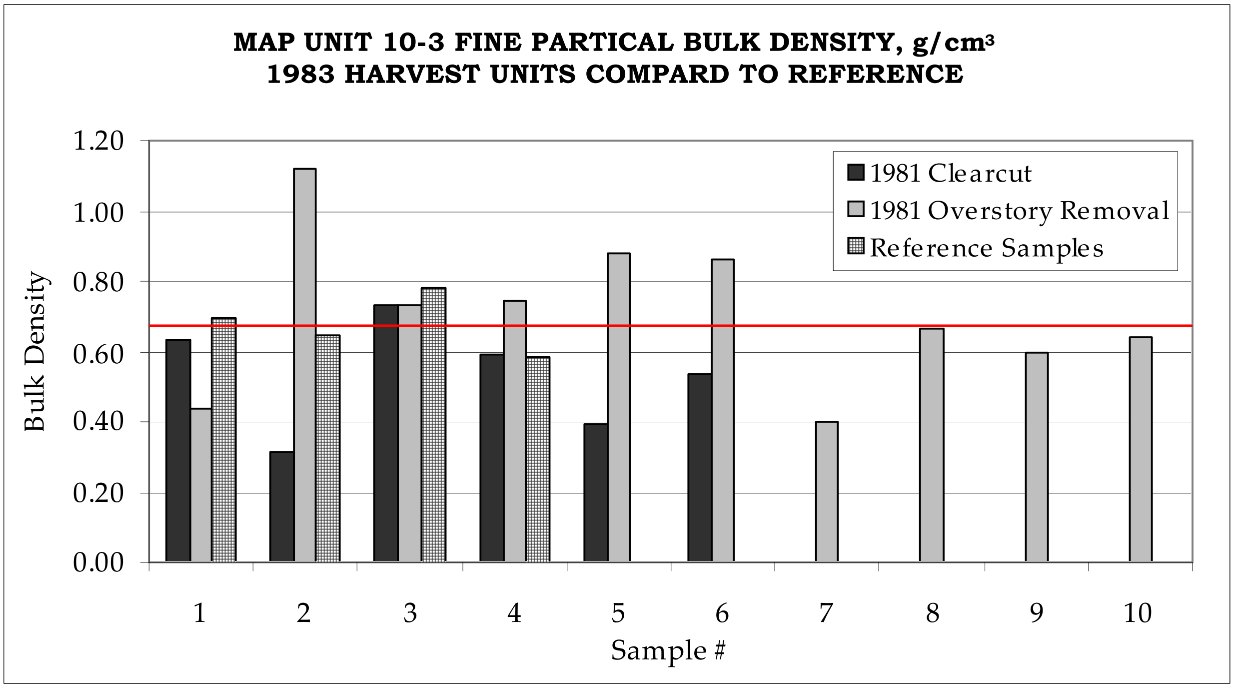


on one unit was clearcut and the other unit was an overstory-removal treatment. Data from bulk density samples collected from each unit and their associated reference sample is presented below in *FIGURE S-5 – SOIL PHYSICAL PROPERTIES IN 1981 HARVEST UNITS*. The red line within the figure indicates the average bulk-density values from reference soil samples of Soil Map Unit 10-3.

Impacts from historic harvests from 1981 can still be observed in the physical soil properties in the overstory-removal harvest unit through slightly elevated bulk-density values as shown below in *FIGURE S-5 – SOIL PHYSICAL PROPERTIES IN 1981 HARVEST UNITS*. Bulk density values in the clearcut are at or below average reference values (depicted by the red line). The values presented below could be attributed to the site-preparation methods used for the clearcut unit as compared to the overstory removal unit. In a regeneration harvest, common practice is to scarify the forest floor to encourage natural regeneration of the stand. This was commonly accomplished with a brush rake attached to a skidder. This practice would have aided compacted areas to recover more rapidly when compared to the overstory removal unit where scarification was not an objective.

Extrapolating these point measurements to the 45-acre overstory-removal harvest unit through randomly placed transects found disturbance levels slightly higher then those observed in the clearcut from 1964. Overall, 10.7 percent of the unit was observed through knife probing to be compacted. Displacement of surface soils was observed on an additional 3.7 percent of the unit, totaling 14.4 percent of the unit recovering from detrimental soil impacts resulting from

FIGURE S-5 – SOIL PHYSICAL PROPERTIES IN 1981 HARVEST UNITS



the 1981 harvest. Again, these data, which provide an excellent insight into natural recovery rates for soil impacts in the project area, are useful when describing the existing conditions of the soil resources and provide helpful insight for forecasting probable impacts for each action alternative.

The most-recent large timber sale on the west side of Swan River State Forest was South Woodward. Soil monitoring was conducted on this timber sale in August of 2003 and reported in *DNRC Compiled Soil Monitoring Report* (*DNRC 2005*). The landtypes on which soil monitoring was conducted in this timber sale were similar to landtypes 26C-8 and 26C-9 in this project area. The monitored harvest unit was a seedtree prescription on slopes ranging from 15 to 45 percent. Monitoring results showed total detrimental impacts to be 4.0 percent of the site and were exclusively displacement-related. No erosion was noted in the harvest unit. Compaction was not physically measured but, except on main skid trails and landings, was noted to be low. Harvest operations were conducted when soil moisture conditions were dry, slopes within the unit were moderate, and no departures from BMPs were noted. These data help to show the effectiveness of site-specific mitigation and BMPs that are incorporated into the timber sale contract and DNRC contract-administration process.

NUTRIENT CYCLING AND SITE PRODUCTIVITY

Coarse and fine woody debris and the organic forest floor provide a critical role in all forested ecosystems through nutrient cycling, microbial habitat, moisture retention and protection of the forest floor, and mineral soil from erosion (*Harmon et al. 1986*). Coarse woody debris decays at various rates and is largely dependant on local climatic conditions with the degree of decay directly related to the service it provides to the ecosystem. Coarse woody debris in advanced stages of decay contains many nutrients (sulfur, phosphorous, and nitrogen), provides important sites for nonsymbiotic nitrogen fixation (*Larson et al. 1978, Wicklow et al. 1973*), and can hold large volumes of moisture for vegetation during dry periods. Forest management can affect the volumes of both fine and coarse woody debris through timber harvesting, resulting in changes (both positive and negative) to site nutrient pools necessary for the long-term nutrient demands of the forest and, thus, long-term productivity of the site.

Surveys of coarse and fine woody material were also conducted in the above-mentioned selected historic harvest units, along with 2 unentered old-growth forest stands as defined by *Green et al.* (*1992*). The results from these surveys can be found below in *TABLE S-3– COARSE AND FINE WOODY DEBRIS VOLUMES*.

Historical nutrient management practices didn't have the benefit of the scientific and research knowledge that we have acquired in the last 2 decades. As shown in the table above, historic harvest units didn't retain adequate volumes of both fine and coarse woody material to replicate conditions in an unmanaged stand. During field reconnaissance, similar ocular estimates of woody material were also observed. Prescriptions for nutrient and slash management for action alternatives would use the knowledge gained during field reconnaissance and those recommended in the literature for various habitat types (*Graham et al. 1994*).

RELATED MANAGEMENT ACTIVITIES

Grazing licenses have never been issued on DNRC-managed land in the project area, resulting in no impacts to soils resources from this management activity. Permits are granted for firewood cutting, and trespass timber harvest has undoubtedly occurred in the project area. These activities generally employ the use of chainsaws, which typically have minimal, if any, detrimental effects to soils.

Currently, no gravel sources have been developed for the west side of Swan River State Forest. Road maintenance and local aggregate applications are being completed from very small, localized borrow sites that are typically developed concurrently with road construction and BMP applications adjacent to the site or are purchased and in-hauled.

ENVIRONMENTAL EFFECTS

This section will disclose the direct, indirect, and cumulative effects of all proposed alternatives. The direct and indirect environmental effects will be summarized by alternative and presented first. Cumulative effects will also be summarized by action alternative and will be presented the section titled *CUMULATIVE EFFECTS BY ALTERNATIVE* immediately following *DIRECT AND INDIRECT EFFECTS*.

Past soil monitoring projects of DNRC timber sales on soils similar to those found in the project area allows informed forecasting of potential effects to soils resource from the implementation of each action alternative. Presented below in *TABLE S-4 – PAST DNRC SOIL MONITORING PROJECTS RELATIVE TO THE WHITE PORCUPINE PROJECT AREA* are soil-monitoring projects completed by DNRC since 1988 that were implemented within the boundaries of the FNF Land System Inventory (*Martinson 1999*). The table presents the soil map unit, sivilcultural prescription, range of slopes in the unit, and

TABLE S-3 – COARSE AND FINE WOODY DEBRIS VOLUMES

SITE/HABITAT TYPE	VOLUME by SIZE-CLASS (INCHES), TONS PER ACRE						
					GREATER THAN 3		TOTAL TONS PER ACRE
	0-.25	.25-.50	.5-1	1.-3	SOUND	ROTTEN	
Unentered old-growth GF/ queencup beadlilly	0.445	1.521	0.152	0.605	0	27.43	30.15
Unentered old-growth GF/ queencup beadlilly	0.79	1.95	0.73	3.87	6.42	14.90	28.66
1981 cverstory removal WRC/queencup beadlilly	0.40	0.85	0.06	2.42	3.21	9.25	16.19
1981 clearcut GF/beargrass	0.08	0.61	0.91	0.81	0.00	5.53	7.94
1964 clearcut WRC/ queencup beadlilly	0.03	0.06	0.18	1.45	0.00	3.67	5.39

GF (grand fir)   WRC (western red cedar)

TABLE S-4 – PAST DNRC SOIL MONITORING PROJECTS RELATIVE TO THE WHITE PORCUPINE PROJECT AREA

PROJECT	SOIL MAP UNIT	PRESCRIPTION	SLOPE (PERCENT)	TOTAL IMPACTS (PERCENT)
Chicken/Werner	26C-8	Seedtree	20 to 50	7.2
South Woodward	23-9	Seedtree	25 to 50	8.1
Goat Rot Hill	26A-9	Clearcut	0 to 15	13.8
Lower Stillwater, Unit 2	28-7	Clearcut	0 to 10	6.4
Lower Stillwater, Unit 6	26G-7	Clearcut	0 to 10	9.0
Dog Meadow North	26C-8	Selective harvest	0 to 29	21.2
			Average	11.0

magnitude of detrimental impacts reported as a percent of the harvest unit. All listed monitoring projects used traditional ground-based skidding equipment. The average value of total impacts will be used to forecast detrimental effects for tractor logging units in each alternative, along with a potential range.

It has been shown that cable logging systems have less soil disturbance than ground-based systems (*Allen 1999; Aulerich 1974; Cromack et al. 1978*). Due to these research findings, to apply a soil disturbance rate from ground-based systems to cable or skyline systems would be inappropriate. DNRC has conducted soil monitoring on 7 harvest units that employed cable logging systems and found that ground disturbance values average 7.0 percent of the unit and range from 2.7 to 11.4 percent (*DNRC 2005*). The results of these findings will be applied to all cable harvest units when predicting potential soil impacts.

DIRECT AND INDIRECT EFFECTS

- ***Direct and Indirect Effects of No-Action Alternative A to Geology and Soils***

  Timber harvesting or road construction would be deferred. Information collected during project development, knowledge from past DNRC soil-monitoring projects and the research community show that soils within the project area would continue on a stable or increasing trend with regard to productivity and hydrologic function. No harvest units would be entered or reentered, resulting in no new detrimental soil impacts. Productivity within historic harvest units would continue to recover with bulk density values and hydrologic function returning to reference conditions. No adverse direct or indirect effects to soils resources would occur under this alternative.

- ***Direct and Indirect Effects of Action Alternative B to Geology and Soils***

  - **Soil Physical Properties**

    Approximately 1,519 acres would be harvested from the project area and 14.0 miles of new road would be constructed. A variety of logging systems would be used to harvest the timber. *TABLE S-5 – PREDICTED SOIL RESOURCE IMPACTS RESULTING FROM ACTION ALTERNATIVE B* presents the expected ranges of detrimental soil effects when certain types of logging systems are used on these approximate amounts of acres.

    Under Action Alternative B, the potential for upland erosion and transport within actual harvest unit boundaries would be low based on field observation of past projects and DNRC monitoring data. Observed erosion is typically limited to compacted locations where organic matter, vegetative cover, and surface soils have been most disturbed and the

TABLE S-5 – PREDICTED SOIL RESOURCE IMPACTS RESULTING FROM ACTION ALTERNATIVE B

HARVEST SYSTEM	ACRES	SOIL IMPACT RATE (PERCENT)	IMPACTED ACRES
Tractor	162	Average: 11.0 Range: 5.3 to 16.7	17.8 Range 8.6 to 27.1
Cable	464	Average: 7.0 Range: 3.6 to 10.5	32.5 Range 16.7 to 48.7
Combination	823	Both cable and tractor rates 78 tractor/22 cable	83.3 Range 40.5 to 126.2
Forwarder	60	Average: 11.0 Range: 5.3 to 16.1	6.6 Range 3.2 to 9.7
New road construction	84.9	100 (50-foot clearing limit)	84.9
Total impacted acres: 225.1 (14.8) Range: 153.9 (10.1) to 296.6 (19.5)			

hydrologic function of the soil has been limited. These locations are usually found on main skid trails and at log landings. On these impacted sites the potential for erosion is a function of the soil texture and physical properties. These risk hazards have been summarized by soil map unit and can be found in *TABLE S-2 – SOIL MAP UNITS AND ATTRIBUTES*. In general, steep impacted sites are most prone to erosion and offsite transport. Erosion from these sites would be mitigated by providing cover with logging slash, installing drainage features on landings and main skid trails, and mechanically ripping heavily impacted sites to assist the hydrologic recovery of the soil.

- **Nutrient Cycling and Site Productivity**

Activities proposed under Action Alternative B would have moderate impacts for a short duration (15 to 20 years) to site nutrient pools and site productivity. The removal of large pools of nitrogen, potassium, and sulfur, along with other micronutrients from the site, through timber harvesting would be mitigated by mimicking natural volumes of coarse and fine woody material observed throughout the project area. The volume of coarse and fine woody material retained on site would vary by habitat type and sivilcultural objective, but would typically range from 15 to 25 tons per acre *(Graham et al. 1994)*.

Slash management and site preparation would be guided by the nutrient-management recommendation established within the research community, by professional experience, and though information gained by monitoring projects. Foliar nutrient characteristics of various conifer species have been well documented (*Moore 2004*). Information gained from this would be used when prescribing slash treatments to insure on-site nutrient pools would be retained to meet nutrient demands of the regenerating stand.

- **Slope Stability**

There would be a moderate risk for activities proposed under Action Alternative B to increase the risk of slope instability for a short period of time both during and after project implementation. This risk, relatively short in duration, would be measured by the time it would take for the site to revegetate. Timber harvesting on approximately 88 acres, or 6.1 percent of the total treated acres, would occur on landtypes prone to mass movement. Within these sensitive sites, sivilcultural prescriptions can be designed to minimize the effect to slope stability by adjusting the volume removed and/or how the unit is marked.

Under Action Alternative B, 0.48 miles or 3.4 percent of the total new road construction would be built on landtypes prone to mass movement. Cutslopes of new road construction could potentially slough and be difficult to revegetate. Numerous mitigations and construction techniques, such as increased site drainage and cut and fill slope stabilization, can be applied to potentially unstable slopes to achieve a stable road prism and would be incorporated into the timber sale contract as necessary. The mitigation techniques mentioned above are very general in nature, but provide the basic concepts that would be adapted into site-specific designs.

- **Gravel Source Development**

New road construction under Action Alternative B would require an aggregate source for road surfacing, armoring culvert inlets and outlets, and future road maintenance needs. A potential source that met the criteria of future gravel source needs and objectives of future management plans was identified during field reconnaissance. The source is approximately 22 acres in size and located in the east half of the southwest quarter of Section 24, T23N, R18W. This site was harvested in 1965 with a regeneration harvest prescription. Temporary roads constructed for the timber sale were abandoned, are still evident, and would be reopened for access to the site. The site consists of a large north-south trending lateral moraine from the Pinedale glacial period. The site is dry, elevated, and devoid of any drainage patterns or channel features. Under Action Alternative B, 100 percent of this site would be developed over time and the land use of this site would be temporarily converted from forest land to transportation-related uses until project activities and maintenance exhausts the aggregate resource, at which time the site will be reclaimed to conditions suitable for timber production.

- ***Direct and Indirect Effects of Action Alternative C to Geology and Soils***

- **Soil Physical Properties**

Approximately 1,563 acres would be harvested from the project area and 9.5 miles of new road would be constructed. A variety of logging systems would be used to harvest the timber. *TABLE S-5 – PREDICTED SOIL RESOURCE IMPACTS RESULTING FROM ACTION ALTERNATIVE C* presents the expected ranges of detrimental soil effects when certain types of logging systems are used on these approximate amounts of acres.

Under Action Alternative C, the potential for upland erosion and transport within actual harvest unit boundaries would be low based on field observation of past projects and DNRC monitoring data. Observed erosion is typically limited to compacted locations where organic matter, vegetative cover, and surface soils have been most disturbed and the hydrologic function of the soil has been limited. These locations are usually found on main skid trails and at log landings. On these impacted sites, the potential for erosion is a function of the soil texture and physical properties. These risk hazards have been summarized by soil-map unit and can be found in *TABLE S-2 – SOIL MAP UNITS AND ATTRIBUTES*. In general, steep impacted sites are most prone to erosion and offsite transport. Erosion from these sites would be mitigated by providing cover with logging slash, installing drainage features on landings and main skid trails, and mechanically

TABLE S-5 – PREDICTED SOIL RESOURCE IMPACTS RESULTING FROM ACTION ALTERNATIVE C

HARVEST SYSTEM	ACRES	SOIL IMPACT RATE (percent)	IMPACTED ACRES
Tractor	289	Average: 11.0 Range: 5.3 to 16.7	31.8 Range: 15.3 to 48.3
Cable	309	Average: 7.0 Range: 3.6 to10.5	21.7 Range: 11.2 to 32.6
Combination	929	Both cable and tractor rates 89 tractor/11 cable	98.1 Range: 47.5 to 148.8
Forwarder	36	Average: 11.0 Range: 5.3 to16.10	4.0 Range 1.9 to 5.8
New road construction	57.3	100 (50-foot clearing limit)	57.3
Total Impacted Acres: 212.9 (13.6) Range: 133.2 (8.5) to 292.8 (18.7)			

ripping heavily impacted sites to assist the hydrologic recovery of the soil.

- **Nutrient Cycling and Site Productivity**

Activities proposed under Action Alternative C would have a moderate impact for a short duration (15 to 20 years) to site nutrient pools and site productivity. Of the 3 action alternatives, Action Alternative C would have the largest impact to nutrient cycling and site productivity. The removal of large pools of nitrogen, potassium, and sulfur, along with other micronutrients from the site through timber harvesting, would be mitigated by mimicking natural volumes of coarse and fine woody material observed throughout the project area. The volume of coarse and fine woody material retained on site would vary by habitat type and sivilcultural objective, but would typically range from 15 to 25 tons per acre (*Graham et al. 1994*).

Slash management and site preparation would be guided by the nutrient-management recommendation established within the research community, by professional experience, and through information gained by monitoring project. Foliar nutrient characteristics of various conifer species have been well documented (*Moore 2004*), and information gained from this would be used when prescribing slash treatments to insure on-site nutrient pools would be retained to meet nutrient demands of the regenerating stand.

- **Slope Stability**

There would be a low risk for actions proposed under Action Alternative C to increase the risk of slope instability during and after project implementation. This risk, relatively short in duration, would be measured by the time it would take for a harvest unit and/or road cut or fill slope to revegetate. Timber harvesting on approximately 4 acres, or less than 1 percent of the total treated acres, would occur on landtypes prone to mass movement. Within these sensitive sites, sivilcultural prescriptions can be designed to minimize the effect to slope stability by adjusting the volume removed and/or how the unit is marked.

Under Action Alternative C, 0.03 miles or less than 1 percent of the total new road construction would be built on landtypes prone to mass movement. Cutslopes of new road construction could potentially slough and be difficult to revegetate. Numerous mitigations and construction techniques such as increased site drainage and cut and fill slope stabilization, can be applied to potentially unstable slopes to achieve a stable road prism and would be incorporated into the timber sale contract as necessary. The mitigation techniques mentioned above are very general in nature, but provide the basic concepts that would be adapted into site-specific designs.

- **Gravel Source Development**

New road construction under Action Alternative C would require an aggregate source for road surfacing, armoring culvert inlets and outlets, and future road maintenance needs. A potential source that met the criteria of future gravel source needs and objectives of future management plan was identified during field reconnaissance. The source is approximately 22 acres in size and located in the east half of the southwest quarter of Section 24, T23N, R18W. This site was harvested in 1965 with a regeneration harvest prescription. Temporary roads constructed for the timber sale were abandoned, are still evident, and would be reopened for access to the site. The site consists of a large north-south trending lateral moraine from the Pinedale glacial period. The site is dry, elevated, and devoid of any drainage patterns or channel features. Under Action Alternative C, 100 percent of this site would be developed over time and the land use of this site would be temporarily converted from forest land to transportation-related uses until project activities and maintenance exhausts the aggregate resource, at which time the site will be reclaimed to conditions suitable for timber production.

- ***Direct and Indirect Effects of Action Alternative D to Geology and Soils***

  - **Soil Physical Properties**

Approximately 1,186 acres would be harvested from the project area and 11.2 miles of new road would be constructed. A variety of logging systems would be used to harvest the timber. *TABLE S-6 – PREDICTED SOIL RESOURCE IMPACTS RESULTING FROM ACTION ALTERNATIVE D* presents the expected ranges of detrimental soil effects when certain types of logging systems are used on these approximate amounts of acres.

Under Action Alternative D, the potential for upland erosion and transport within actual harvest unit boundaries would be low based on field observation of past projects and DNRC monitoring data. Observed erosion is typically limited to compacted locations where organic

TABLE S6 – PREDICTED SOIL RESOURCE IMPACTS RESULTING FROM ACTION ALTERNATIVE D

HARVEST SYSTEM	ACRES	SOIL IMPACT RATE (PERCENT)	IMPACTED ACRES
Tractor	50	Average: 11.0 Range: 5.3 to 16.7	5.5 Range 2.7 to 8.4
Cable	416	Average: 7.0 Range: 3.6 to10.5	29.1 Range 15.0 to 43.7
Combination	720	Both cable and tractor rates 80 tractor/20 cable	73.4 Range 35.7 to 111.3
Forwarder	0	Average: 11.0 Range: 5.3 to 16.10	0
New road construction	65.9	100 (50-foot clearing limit)	65.9
Total impacted acres: 173.9 (14.6) *Range: 119.3 (10.1) to 229.3 (19.3)*			

matter, vegetative cover, and surface soils have been most disturbed and the hydrologic function of the soil has been limited. These locations are usually found on main skid trails and at log landings. On these impacted sites the potential for erosion is a function of the soil texture and physical properties. These risk hazards have been summarized by soil map unit and can be found in *TABLE S-2 – SOIL MAP UNITS AND ATTRIBUTES*. In general, steep impacted sites are most prone to erosion and offsite transport. Erosion from these sites can be mitigated by providing cover with logging slash, installing drainage features on landings and main skid trails, and mechanically ripping heavily impacted sites to assist the hydrologic recovery of the soil.

- **Nutrient Cycling and Site Productivity**

Activities proposed under Action Alternative D would have a moderate impact for a short duration (15 to 20 years) to site nutrient pools and site productivity. Action Alternative D would have the least impact to nutrient cycling and site productivity of all the action alternatives. The removal of large pools of nitrogen, potassium, and sulfuralong with other micronutrients from the site through timber harvesting, would be mitigated by mimicking natural volumes of coarse and fine woody material observed throughout the project area. The volume of coarse and fine woody material retained on site would vary by habitat type and siviculture objective, but would typically range from 15 to 25 tons per acre (*Graham et al. 1994*).

Slash management and site preparation would be guided by the nutrient management recommendation established within the research community, by professional experience, and through information gained by monitoring projects. Foliar nutrient characteristics of various conifer species have been well documented (*Moore 2004*). Information gained from this would be used when prescribing slash treatments to insure on-site nutrient pools would be retained to meet nutrient demands of the regenerating stand.

- **Slope Stability**

  There is a moderate risk for activities proposed under Action Alternative D to increase the risk of slope instability for a short period of time both during and after project implementation. This risk, relatively short in duration, would be measured by the time it would take for the site to revegetate. Timber harvesting on approximately 76 acres, or 6.4 percent of the total treated acres, would occur on landtypes prone to mass movement. Within these sensitive sites, sivicultural prescriptions can be designed to minimize the effect to slope stability by adjusting the volume removed and/or how the unit is marked.

  Under Action Alternative D, 0.46 miles, or 4.1 percent, of the total new road construction would be built on landtypes prone to mass movement. Cutslopes of new road construction could potentially slough and be difficult to revegetate. Numerous mitigations and construction techniques, such as increased site drainage and cut and fill slope stabilization, can be applied to potentially unstable slopes to achieve a stable road prism and would be incorporated into the timber sale contract as necessary. The mitigation techniques mentioned above are very general in nature, but provide the basic concepts that would be adapted into site-specific designs.

- **Gravel Source Development**

  New road construction under Action Alternative D would require an aggregate source for road surfacing, armoring culvert inlets and outlets, and future road maintenance needs. A potential source that met the criteria of future gravel source needs and objectives of the future management plans was identified during field reconnaissance. The source is approximately 22 acres in size and located in the east half of the southwest quarter of Section 24, T23N, R18W. This site was harvested in 1965 with a regeneration harvest prescription. Temporary roads constructed for the timber sale were abandoned, are still evident, and would be reopened for access to the site. The site consists of a large north-south trending lateral moraine from the Pinedale glacial period. The site is dry, elevated, and devoid of any drainage patterns or channel features. Under Action Alternative D, 100 percent of this site would be developed over time and the land use of this site would be temporarily converted from forest land to transportation-related uses until project activities and maintenance exhausts the aggregate resource, at which time the site will be reclaimed to conditions suitable for timber production.

CUMULATIVE EFFECTS

As previously mentioned, for a proposed action to have cumulative effects to soil resources, the action must overlap a previous or potential future action. The overlap refers to both the harvest unit in question and 2 points in time. The following summarizes cumulative effects by each alternative.

- ***Cumulative Effects of No-Action Alternative A to Geology and Soils***

  No timber harvesting or road construction would be implemented. No new impacts to the soils resources would be expected and soil productivity would continue on a stable to upward trend resulting from continual amelioration of past soil impacts. Nutrient cycling would continue as both coarse and fine woody materials decay and are incorporated into the soil profile as organic matter and soil wood. Potential future actions to actively manage the stands selected in each alternative is foreseeable, but the design and objectives of future projects is impractical to predict. Small sanitation, salvage, and firewood permits would continue to be offered within the project area under No-Action Alternative A. If stands are reentered in potential future projects or permits, historic skid trails and landings would be reused and all relevant BMPs and mitigations would be included into the project design to minimize the potential of cumulative effects.

- ***Cumulative Effects of Action Alternative B to Geology and Soils***

  A total of 7.7 acres in 3 separate harvest units that has had past management activities since the 1960s would be reentered. Activities prior to 1960 are poorly documented, but typically were the clearcut harvest method was used; if this is the case, past management activities would be easily observed through stand age. Most pre-1960s' activities that were identified in the selected harvest units resulted in select cutting and low impacts to the soil resouce. Field reviews of these post-1960s' impacts were observed to have naturally ameliorated on all but the most heavily impacted skid trails (approximately less than 1.0 percent of the unit), which would be reused if properly located. The stands that would be reentered under Action Alternative B were treated in 1964 and 1981 with clearcut and overstory removal prescriptions, respectively. Data presented under *EXISTING ENVIRONMENT* of this analysis show that impacts within historical sites have been ameliorated on all but the most heavily impacted skid trails and log landings. To minimize the potential of cumulative impacts to physical soil properties in these areas, historic skid trails would be reused if properly located. Due to the mitigations and BMPs that would be applied in these areas, along with the relatively small amount of acres that would be reentered, the risk and impact of cumulative effects to soil physical properties is low.

  No historically managed sites in the project area were observed to contain chronic erosion features. All past impacted sites have revegetated naturally and have returned or are returning to their natural base erosion rates. No cumulative effects from erosion within the analysis area are expected.

  There would be a low risk of cumulative effects to nutrient pools within the reentered stands. Stands that contain adequate levels of both fine and coarse woody material would have slash-management prescriptions to maintain a stable nutrient cycling trend. If a site's nutrient retention levels were mismanaged in the 1960s, the reentry allows DNRC to manage nutrient retention to achieve desired volumes of both fine and coarse woody debris that mimics those found in similar habitat types and prescribed in the best available science (*Graham et al. 1994*).

Currently, approximately 5.5 miles of road has been built or is planned to be built in the project area on a map unit identified to be considered prone to mass failure by this report and the FNF Land System Inventory. Under Action Alternative B, approximately 0.47 miles of new road would be constructed across this map unit. This comprises 8.5 percent of the transportation system that has been built or is planned to be built on this map unit. Due to the short length of new construction and the lack of field observation of mass movements within the project area on this map unit, the risk of cumulative effects to slope stability from road construction activities are expected to be low.

In summary, all additive impacts from various management activities affect the long-term productivity of a site. Due to the small amount of acres proposed for reentry under this alternative, data and information gained from historic harvest units, and levels of coarse and fine woody debris that would be retained for nutrient cycling, a low risk of low-level impacts would occur to long-term soil productivity. Cumulative effects on acres not previously harvested would be the same as those reported in *DIRECT AND INDIRECT EFFECTS*.

- ***Cumulative Effects of Action Alternative C to Geology and Soils***

A total of 39.4 acres within 5 separate harvest units that had past management activities since the 1960s would be reentered. Activities prior to 1960 are relatively poorly documented, but typically were clearcut; if this is the case, past management activities would be easily observed through stand age. Most post-1960s' activities that were identified within the selected harvest units resulted in select cutting and low soil-resource impacts. Field reviews of these pre-1960s' impacts were observed to have naturally ameliorated on all but the most heavily impacted skid trails (approximately less than 1.0 percent of the unit), which would be reused if properly located. The stands that would be reentered under Action Alternative C were treated in 1964 and 1981 with clearcut and overstory removal prescriptions, respectively. Data presented in *EXISTING ENVIRONMENT* in this analysis show impacts within historic harvest units have been ameliorated on all but the most heavily impacted skid trails and log landings. To minimize the potential of cumulative impacts to physical soil properties in these areas, historic skid trails would be reused if properly located. Due to the mitigations and BMPs that would be applied in these areas, along with the relatively small amount of acres that would be reentered, the risk and impact of cumulative effects to soil physical properties would be low.

No historically managed sites in the project area were observed to contain chronic erosion features. All past impacted sites have revegetated naturally and have returned or are returning to their natural base erosion rates. No cumulative effects from erosion within the analysis area are expected.

There would be a low risk of cumulative effects to nutrient pools within the reentered stands. Stands that contain adequate levels of both fine and coarse woody material would have slash-management prescriptions to maintain a stable nutrient cycling trend. If a site's nutrient retention levels was mismanaged in the 1960s, the reentry allows DNRC to manage nutrient retention to achieve desired volumes of both fine and coarse woody debris that mimics those found in similar habitat types and prescribed in the best available science (*Graham et al. 1994*).

Currently, approximately 5.5 miles of road has been built or is planned to be built in the project area on a map unit identified to be considered prone to mass failure by this report and the FNF Land System Inventory. Under Action Alternative C, approximately 175 feet of new road would be constructed across this map unit. This comprises less than 1 percent of the transportation system that has been built or is planned to be built on this map unit. Due to the short length of new construction and the lack of field observation of mass movements in the project area on this map unit, the risk of cumulative effects to slope stability from road construction activities is low.

In summary, all additive impacts from various management activities affect the long-term productivity of a site. Due to the relatively small amount of acres proposed for reentry under this alternative, data and information gained from historic harvest units, and levels of coarse and fine woody debris that would be retained for nutrient cycling, a low risk of low level impacts would occur to long-term soil productivity. Cumulative effects on acres not previously harvested would be the same as those reported in *DIRECT AND INDIRECT EFFECTS*.

- ***Cumulative Effects of Action Alternative D to Geology and Soils***

A total of 3.3 acres within 2 separate harvest units that had past management activities since the 1960s would be reentered. Activities prior to 1960 are relatively poorly documented, but typically were clearcut; in this case, past management activities would be easily observed through stand age. Most post-1960s' activities that were identified in the selected harvest units resulted in select cutting and low soil-resource impacts. Field reviews of these pre-1960s' impacts were observed to have naturally ameliorated on all but the most impacted skid trails (approximately less than 1.0 percent of the unit), which would be reused if properly located. The stands that would be reentered under Action Alternative D were treated in 1964 and 1981 with clearcut and overstory removal prescriptions, respectively. Data presented in *EXISTING ENVIRONMENT* in this analysis show that impacts within historic harvest units has been ameliorated on all but the most heavily impacted skid trails and log landings. To minimize the potential of cumulative impacts to physical soil properties in these areas, historic skid trails would be reused if properly located. Due to the mitigations and BMPs that would be applied in these areas, along with the relatively small amount of acres that would be reentered, the risk and impact of cumulative effects to soil physical properties would be low.

No historically managed sites in the project area were observed to contain chronic erosion features. All past impacted sites have revegetated naturally and have returned or are returning to their natural base erosion rates. No cumulative effects from erosion in the analysis area are expected.

There would be a low risk of cumulative effects to nutrient pools in the reentered stands. Stands that contain adequate levels of both fine and coarse woody material would have slash-management prescriptions to maintain a stable nutrient cycling trend. If a site's nutrient-retention levels were mismanaged in the 1960s, the reentry allows DNRC to manage nutrient retention to achieve desired volumes of both fine and coarse woody debris that mimics those found in similar habitat types and prescribed in the best available science (*Graham et al. 1994*).

Currently, approximately 5.5 miles of road has been built or is planned to be built in the project area on a map unit considered prone to mass failure identified by this report and the FNF Land System Inventory. Under Action Alternative D, approximately 0.46 miles of new road would be constructed across this map unit. This comprises 8.4 percent of the transportation system that has been built or is planned to be built on this map unit. Due to the short length of new construction and the lack of field observation of mass movements in the project area on this map unit, the risk of cumulative effects to slope stability from road construction activities would be low.

In summary, all additive impacts from various management activities affect the long-term productivity of a site. Due to the relatively small amount of acres proposed for reentry under this alternative, data and information gained from historic harvest units, and levels of coarse and fine woody debris that would be retained for nutrient cycling, a low risk of low level impacts would occur to long-term soil productivity. Cumulative effects on acres not previously harvested would be the same as those reported in *DIRECT AND INDIRECT EFFECTS*.

INTRODUCTION

This analysis describes the existing economic environment and identifies the potential direct, indirect, and cumulative economic effects associated with the proposed action.

ISSUES AND MEASUREMENT CRITERIA

Concerns were raised during the scoping period regarding the potential effects the proposed action may have on the economic resource. The following issue statement was crafted to account for those concerns and guide the analysis of this section:

> *The proposed action may affect revenue generated for the Common School Trust, funding for FI projects, timber-related employment, and revenue generated in the regional economy.*

The following measurement criteria were selected to describe the existing environment of the economic resource in the area and to 'measure' the extent of the potential direct, indirect, and cumulative economic effects under each alternative:

- For revenue, the measurement criterion is dollars distributed to the Common School Trust, FI program, and regional economy.
- For employment, the measurement criterion is the number of timber-related jobs provided.

ANALYSIS AREA

The geographic scope of the economic analysis includes the 3 counties closest in proximity to the proposed action. This 3-county area (Flathead, Lake, and Missoula County) is both geographically and economically relevant to the proposed action. The temporal scope of the economic analysis is the duration of the proposed activities.

ANALYSIS METHODS

Stumpage revenue for the proposed action is estimated using a timber appraisal method based partially on transaction evidence. The method predicts bid prices by combining information from the regression analysis of recently sold timber sales, sale variables (e.g. species mix, development costs, logging techniques, transportation costs), and current market indexes (e.g. industry price indexes, species price indexes).

FI fees are estimated using the current FI fee schedule set at $27.30 per Mbf.

Estimated forest-management revenues and expenditures for the proposed project were based on a 3-year average operational revenue/cost ratio of 2.09 for the Northwestern Land Office. This ratio means that an average of $2.09 was earned in revenue for every $1.00 spent over the last 3 years in the Northwestern Land Office forest-management program.

The employment multiplier used in this analysis is an average of 10.0 jobs supported by every million board feet (MMbf) of timber harvested in the analysis area (*Bureau of Business and Economic Research, 2008*). The exactness of this employment multiplier is limited as the real change in employment varies from sale to sale. Jobs calculated using this multiplier represent mostly existing direct industry jobs that are maintained 1 full year due to this timber sale.

Wages and salaries are estimated using an industry average wage in the 3-county area of $40,897 as reported in *TABLE E-1 EMPLOYMENT AND WAGE - County Employment and Average Wages 2006.*

TABLE E-1-EMPLOYMENT AND WAGE County Employment and Average Wages 2006

County	Industrial Sector	Jobs	Salaries	Wages
Flathead	Crop Production	97	$4,187,501	$43,170
	Animal Production	17	$981,622	$57,742
	Forestry and Logging	235	$10,575,019	$45,000
	Services	38	$918,862	$24,181
	Total	39623	$1,188,896,076	$35,920
Lake	Crop Production	67	$1,042,393	$15,558
	Animal Production	NA	NA	NA
	Forestry and Logging	40	$1,059,168	$26,479
	Ag. and Forest Support	8	$206,754	$25,844
	Total	8343	$220,399,990	$26,891
Missoula	Crop Production	51	$1,811,537	$35,520
	Animal Production	25	$1,026,354	$41,054
	Forestry and Logging	220	$7,755,297	$35,251
	Ag. and Forest Support	104	$5,536,872	$53,239
	Total	54437	$1,669,038,865	$36,646

EXISTING ENVIRONMENT

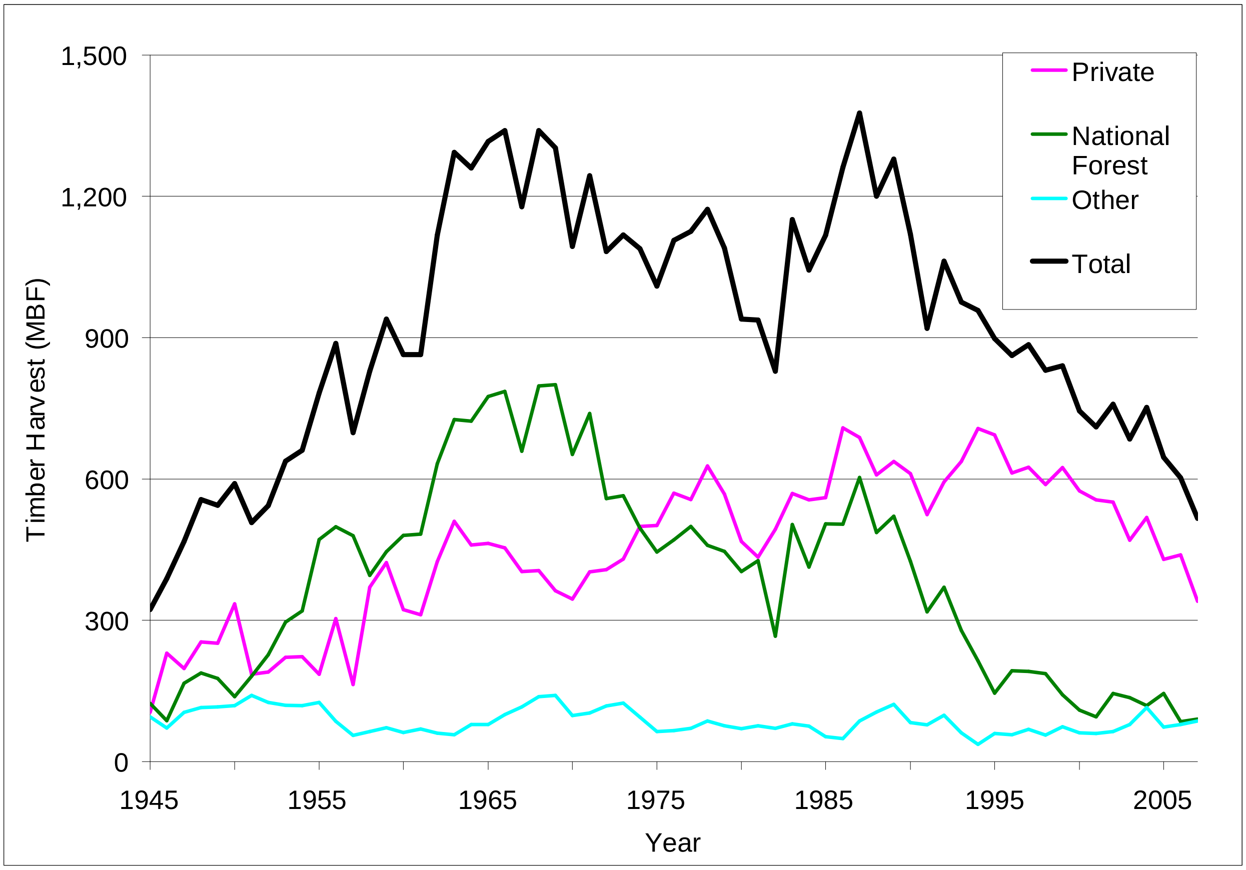
The proposed action would take place on Swan River State Forest, located in the southeastern corner of Lake County. The proposed project is in an area with relatively low population density. Swan River State Forest timber sales generally supply raw materials for lumber, plywood, and pulp industries in Lake, Missoula, and Flathead counties. Flathead County includes the northern portion of Flathead Lake and the west side of Glacier Park. Lake County encompasses a large part of Flathead Lake and includes much of the Flathead Indian Reservation. Missoula County is located to the south of Flathead County and encompasses Missoula Valley and the greater surrounding area.

Though the overall economy in each county is different, they share a forestry and logging industry. Following the recent closure of the Stimpson Lumber Company in Bonner, there are still 2 timber processing facilities now remaining in Missoula County, 1 in Flathead County, and 6 in Lake County. Employment and wages for select industrial sectors (*NAICS*) in the 3-county area are described in detail below *(TABLE E-1 - EMPLOYMENT AND WAGES).* Forestry and logging employment data *(Montana Department of Labor and Industry, Research and Analysis Bureau*) is likely lower than actual employment due to missing data on a number of small, informal logging and milling operations.

Historically, harvesting activites in Montana's timber-related industries has fluctuated. *(FIGURE E-1 - TIMBER HARVEST)* shows the aggregate timber-harvesting activity in the state of Montana. The more recent volume decline is, in part, a reflection of the USFS diminishing contribution to statewide harvesting levels. Currently, DNRC has an annual statewide sustained-yield of 53.2 MMbf.

DNRC-managed forests contribute revenues to public schools based on endogenous (harvested volume) and exogenous (market prices) factors. Timber sale revenues distributed to Montana public schools vary more widely than the respective volume sold. This additional variability in revenue

FIGURE E-1 - TIMBER HARVEST. Total timber harvesting in Montana forests 1945 through 2007.



comes from timber prices which fluctuate according to supply and demand events in national and international markets. (*TABLE E-2 - TIMBER SALE REVENUE)* shows gross revenue from harvests, net revenues distributed to the Montana public schools, and FI fees collected over the last 5 years.

The total Montana kindergarten through12 public school general fund budget in the 2006 and 2007 school year was $857 million (*Montana Office of Public Instruction*). Of this the State contributed $532 million (62 percent). Slightly more than $54 million (10.3 percent) of the State's contribution to kindergarten through 12 schools came from revenues generated from the management of state trust lands. In recent years, timber sale revenues have made up between 4 and 25 percent of this state trust land payment.

In the same 2006 and 2007 school year, 144,418 students were enrolled in kindergarten through 12 public schools in

TABLE E-2 - TIMBER SALE REVENUE

Year	Gross Timber Revenue	Timber Revenue Distributed to Trusts	Forest Improvement Fees Collected
2007	$8,799,298	$2,286,943	$1,316,404
2006	$15,875,615	$8,262,120	$2,875,277
2005	$16,596,191	$9,075,011	$2,944,559
2004	$11,043,525	$4,783,274	$2,029,625
2003	$8,278,792	$3,138,699	$1,363,664

Montana. The number of students funded by timber sales can be measured by taking the 2006 and 2007 education cost per student of $5,934 and comparing it to the fiscal year (FY) 2007 distributed timber revenue. Using this figure it is estimated that timber revenues funded approximately 386 students in FY 2007. As a whole, state trust lands would have funded approximately 9,135 students.

In addition to timber sale revenues, FI fees are collected and used to finance projects that improve the health, productivity, and value of forested trust lands. FI activities may include piling and disposal of logging slash, reforestation, thinning, prescribed burning, site preparation, noxious-weed control, seed collection, acquiring access, and maintaining roads necessary for timber harvesting, monitoring, other activities necessary to improve the condition and income potential of forested state lands, and to comply with other legal requirements associated with timber harvesting (*77-5-204, MCA*).

ENVIROMENTAL EFFECTS

Direct economic environmental effects are those that alter trust land revenues and timber-related industries in the 3-county area. Indirect economic environmental effects are those that alter other sectors in the economy. Cumulative economic environmental effects are typically seen as those that contribute to long-term changes in any part of the economy. MEPA defines cumulative effects as "collective impacts on the human environment of the proposed action when considered in conjunction with other past, present, and future actions related to the proposed action by location or generic type" (*MCA 75-1-220(3)*). Therefore, for this analysis, cumulative effects will consider projects listed in *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* under *SCOPE OF THIS EIS* in *CHAPTER I* as well as other timber sale activities throughout the analysis area.

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Economics***

  This alternative would have direct, indirect, and cumulative effects on revenue and employment in the 3-county analysis area. Regional direct and indirect effects that would occur under this alternative can be described as the forfeiting, or loss, of effects associated with the proposed action. If timber from this project is not sold, equivalent volumes could come from sales elsewhere; however, benefits would be dispersed across those alternative harvesting areas.

  This alternative would have unique cumulative effects in that long-term deferral of harvesting from this forest may encourage further downsizing of the industry infrastructure. In 2000, timber-related industry paid taxes of nearly $1,914,000 to schools in Flathead, Lake, and Missoula counties. These tax contributions would decline in the future if mill closures continue. The foregoing of a single timber sale would not likely influence the closing of a mill, but the cumulative effects of reduced timber harvesting overtime would.

- ***Direct Effects of Action Alternatives B, C, and D to Economics***

  The direct effects (*TABLE E-3 - DIRECT REVENUE AND EMPLOYMENT EFFECTS)* associated with the action alternatives are estimated to lie between

TABLE E-3 - DIRECT REVENUE AND EMPLOYMENT EFFECTS

Direct Effects	Alt. A	Alt. B	Alt. C	Alt. D
Acres Harvested	0	1,519	1,563	1,186
Harvest Volume (Mbf)	0	21,461	24,161	15,497
Harvest Volume (Tons)	0	128,766	144,966	92,982
Stumpage Price ($/Ton)	$0	$23.65	$25.79	$23.68
Stumpage Revenue	$0	$3,045,795	$3,738,221	$2,202,067
Forest Improvement Fee	$0	$585,885	$659,595	$423,068
Total State Revenue	$0	$3,631,680	$4,397,816	$2,625,135
Total State Expenditures	$0	$1,457,318	$1,788,622	$1,053,621
Total Trust Revenue	$0	$1,588,477	$1,949,598	$1,148,446
Trust Revenue Per Acre	$0	$1,046	$1,247	$968
Students Funded for One Year	0	268	329	194
Total Employment	0	215	242	155
Total Wages and Salaries	$0	$8,777,102	$9,881,345	$6,337,950

$1.1 and $1.9 million in state trust land revenue, 155 and 242 timber-industry jobs, and $6.3 and $9.8 million in timber-industry earnings. Action Alternative C has the greatest revenue and employment effect, followed in order by Action Alternatives B and D.

These direct-effect measurements are intended for the relative comparison of alternatives and are not intended as absolute estimates of revenue, employment, and wages. Revenue in this table is specific to the State of Montana; employment and wages are specific to the timber industry in the 3-county area. The estimated timber jobs represent sustained positions in the economy over the period of the proposed action. These positions may or may not be new to the economy. Wages and salaries represent revenues earned though value-added manufacturing processes.

- ***Indirect Effects of Action Alternative B, C, and D to Economics***

While direct effects occur within timber-related industries, indirect effects represent the additional spending that would occur in other industries. Due to insufficient data for the region, to measure and scale indirect effects between alternatives is difficult. However, it is possible to rank alternatives based on direct effects because indirect effects remain proportional to direct effects; therefore, Action Alternative C would have the greatest indirect effects on the regional economy, followed in order by Action Alternatives B and D.

- ***Cumulative Effects of Action Alternative B, C, and D to Economics***

Each action alternative would contribute volume to the annual sustained yield. This yield establishes a relatively stable supply of state trust land timber for the regional market. The State's regional market share is growing more significant as other timber supply sources dwindle. While the region's market health ultimately relies on energy and lumber prices established in international markets and affordable local timber supply is still necessary for regional processing facilities to remain competitive and open. Therefore, one of the cumulative effects of the proposed action in conjunction with other timber harvests is the preservation of economic viability in Montana's timber resources.

The proposed action also contributes proportionally to public school funding. Funds distributed from revenues earned from state trust lands partially offsets tax dollars needed to fund public education. The cumulative effect of this proposed action in conjunction with other trust land revenue-generating activities is the continued financial contribution to public education in Montana. Tax dollars offset by these contributions either go to improve the State of Montana's budget for other public services or they benefit Montana tax payers by reducing their tax burden. Relative to an individuals total state tax liability, the reduction in tax burden by timber sales, cumulatively speaking, is still very small.

Also, the proposed action contributes to the overall size of the FI fund. In the long term, FI funding represents an investment in forest health, future income-generating opportunities, fire protection, and other associated benefits. The economic benefits of work conducted with FI funds cannot directly be measured, but they represent an additional cumulative effect related to the proposed action.

AIR QUALITY ANALYSIS

INTRODUCTION

This analysis describes the existing air quality and discloses the potential direct, indirect, and cumulative environmental effects the proposed action (*see CHAPTER I – PURPOSE AND NEED*) may have on air quality throughout the area.

ISSUES AND MEASUREMENT CRITERIA

ISSUES

The following issues concerning air quality were raised during internal and external scoping and will be analyzed in further detail in this analysis:

- Smoke produced from prescribed burning associated with the proposed action may adversely affect local air quality.
- Dust produced from road construction, road maintenance, harvest-related traffic, gravel pit development, and operations associated with the proposed action may adversely affect local air quality.

MEASUREMENT CRITERIA

Quantitative and qualitative changes to the following measurement criteria are intended to 'measure' the extent of the potential direct, indirect, and cumulative environmental effects the proposed action may have on existing air quality in the area.

- To determine the impacts from smoke, the measurement criteria include: the amount, location, timing (including season), and duration of prescribed burning.
- To determine the impacts from dust, the measurement criteria include: the amount, location, timing (including season), and duration of road construction and maintenance, harvest-related traffic, and gravel pit development and operation.

ANALYSIS AREA

The analysis area used to determine direct, indirect, and cumulative environmental effects of the proposed action on air quality includes all of the Swan River Subbasin (fourth-level hydrologic unit) and all lands within a 5-mile buffer distance outside the boundary of the subbasin.

ANALYSIS METHODS

The methodologies used to determine the environmental effects of the proposed action on air quality within the project and surrounding areas include estimating the amount, location, timing, and duration of smoke and dust generated by activities associated with the proposed action. Cumulative effects include consideration of other actions indicated in *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* under *SCOPE OF THIS EIS* in *CHAPTER I*.

RELEVANT AGREEMENTS, LAWS, PLANS, PERMITS, LICENSES, AND OTHER REQUIREMENTS

CLEAN AIR ACT OF MONTANA

MCA 75-2-101 through *429* is known as the Clean Air Act of Montana and requires the State of Montana to provide for a coordinated statewide program to prevent, abate, and control air pollution while balancing the interest of the public.

MONTANA/IDAHO AIRSHED GROUP

DNRC is a member of the Montana/Idaho Airshed Group, which was formed to minimize or prevent smoke impacts while using fire to accomplish land-management objectives and/or fuel hazard reduction (*Montana/Idaho Airshed Group 2006*). The Airshed Group determines the delineation of airsheds and impact zones throughout Idaho and Montana. As a member, DNRC must submit burn plans to the smoke-monitoring unit that describe the type of burn to be conducted, the size of the burn in total acres, and the location and elevation of each burn site. The smoke-monitoring unit provides timely restriction messages by airshed. DNRC and other cooperators are required to abide by those restrictions and burn only when conditions are conducive to good smoke dispersion.

AIR QUALITY MAJOR OPEN-BURNING PERMIT

DEQ issues permits to entities that are classified as major open burners (*ARM 17.8.610).* DNRC is permitted to conduct prescribed wildland open-burning activities that are either deliberately or naturally ignited. Planned prescribed burn descriptions must be submitted to DEQ and the smoke-monitoring unit of the Montana/ Idaho Airshed Group. All burns must be conducted in accordance with the major open-burning permit.

EXISTING ENVIRONMENT

The analysis area is located within Montana Airshed 2, which encompasses the entire Flathead and Lake counties, most of Sanders County, and the smaller, northernmost portions of Missoula, Mineral, and Powell counties. The Project Area (*see CHAPTER I – PURPOSE AND NEED*) is located 7 to 15 miles from 3 local population centers: Swan Lake, Salmon Prairie, and Condon.

The analysis area occurs outside of designated 'impact zones' that refer to areas the Montana/Idaho Airshed Group or affiliated local program identifies as smoke sensitive and/or having an existing air-quality problem. Within the periphery of the analysis area are 3 "Class I Areas", which include the Mission Mountain and Bob Marshall wilderness areas and the Flathead Indian Reservation. Both wilderness areas are considered Mandatory Federal Class I Areas, which refer to areas specified as Class I by the 1977 Clean Air Act and include international and national parks greater than 6,000 acres and national wilderness areas greater than 5,000 acres that existed on August 7, 1977. The Flathead Indian Reservation is considered a non-Federal Class I Area, yet still receives recognition and protection under the 1977 Clean Air Act.

Air quality in the analysis area is generally excellent and has limited local emission sources and consistent wind dispersion throughout most of the year. Existing emission sources include residential wood-burning stoves, private homeowner debris burns, road dust created by recreational or forest-management activities, and periodic wildland fires and prescribed burns on federal, private, state, and tribal forested lands. Prevailing winds typically blow from west to east; thus, emissions from activities in the western portion of the analysis area tend to drift into the valley bottom, particularly during the late afternoon and evening. Currently, emissions do not affect local population centers, impact zones, or Class I Areas beyond EPA and DEQ standards. All burning activities by major burners comply with emission levels authorized by the Montana/Idaho Airshed Group.

ENVIRONMENTAL EFFECTS

- ***Direct and Indirect Effects of No-Action Alternative A to Air Quality***

  No prescribed burning, road construction and maintenance, harvest-related traffic, or gravel pit development and operation would occur. Therefore, direct and indirect effects to air quality as a result of this alternative would not be expected.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Air Quality***

While some differences in harvest amounts and road miles between the 3 action alternatives exist, the amount of particulate matter released into the analysis area is expected to be indistinguishable between alternatives. The only distinguishable difference between alternatives occurs in the location of emission sources. Sources associated with Action Alternatives B and D would be spread throughout the Project Area, while those associated with Action Alternative C would be concentrated in the northern portion of the Project Area.

- **Prescribed Burning**

Under each action alternative, DNRC would conduct prescribed burning following harvesting activities in order to remove residual logging waste and fine fuels. These burning activities would subsequently reduce fire risk in the area and prepare site conditions conducive to tree regeneration. Starting in the fall of 2009, 100 to 120 piles of slash would be burned per year over a period of 3 to 5 years. The portions of units utilizing cable harvesting methods would be slated for broadcast burning that could take place up to 5 years postharvest.

Burning, which would vary by location under each action alternative, would likely occur during the months of October, November, April, May, and June during conditions that are conducive to good smoke dispersion. Actual burning days would be controlled and monitored by DEQ and the smoke monitoring unit of the Montana/Idaho Airshed Group and would meet EPA standards, which would further minimize the direct and indirect effects of burning activities.

- **Road Construction and Maintenance**

Under each action alternative, operators conducting new road construction and road maintenance on existing roads are expected to produce particulate matter (*TABLE A-1 – ROAD CONSTRUCTION AND MAINTENANCE*).

Over the 3-year operating period, 6 to 8 timber sales are expected to be implemented. Varying levels of road construction and maintenance would typically occur prior to each sale and during drier conditions to avoid damaging road-drainage features. Depending on the size and location of each sale, 1 to 4 miles of new road construction and 20 to 30 miles of road maintenance would occur at any time during the months of June through November, conditions permitting. Depending on the season and conditions of the road, DNRC would

TABLE A-1 – ROAD CONSTRUCTION AND MAINTENANCE. Miles of new road construction and maintenance by action alternative.

ACTION ALTERNATIVE	NEW ROAD CONSTRUCTION (MILES)	ROAD MAINTENANCE (MILES)
B	14.0	62.9
C	9.5	41.6
D	11.2	60.4

require that harvest purchasers apply dust abatement to segments of roads in order to reduce particulate emissions.

Direct and indirect effects to air quality as a result of road construction and maintenance are expected to be localized to the roadways and areas directly adjacent to the roadways. Vegetative barriers along the roadside and dust-abatement mitigations are expected to greatly limit the dispersion of particulate matter beyond these areas. Thus, direct and indirect effects to air quality throughout the analysis area as a result of road construction and maintenance are expected to be minor.

- **Harvest-Related Traffic**

Under each action alternative, harvest-related traffic on gravel roads would be expected to produce particulate matter. According to the analysis conducted in the *RECREATION ANALYSIS*, approximately 5,800 to 8,000 harvest-related trips would be expected per year over the 2.5- to 3-year operating period (see *TABLE R-3 – HARVEST-RELATED TRAFFIC*). Traffic on designated restricted roads would be limited to 9 months due to restrictions during the grizzly bear denning period (April 1 through June 15) that are enforced under the SVGBCA. Traffic along open roads would likely continue during the denning period, but at rates lower than those expected outside of the denning period.

Dust production on roads during the dry summer and fall months would likely be higher than during the late fall, winter, and early spring months when frozen ground conditions and/or higher levels of moisture are expected to abate particulate production. During the dry months, log-, rock-, and equipment-hauling traffic would be expected to produce more particulate matter than the other harvest-related traffic due to the size and weight of the vehicles.

Half to two-thirds of the harvest operations would occur during the dry months, while the other remaining proportion would occur during wetter months. Depending on the season and condition of the road, DNRC would require that harvest operators apply dust abatement to segments of roads used for hauling and other harvest-related traffic in order to reduce particulate emissions.

Direct and indirect effects to air quality as a result of harvest-related traffic are expected to be localized to the roadways and areas directly adjacent to the roadways. Vegetative barriers along the roadside and dust abatement mitigations are expected to greatly limit the dispersion of particulate matter beyond these areas. Thus, direct and indirect effects to air quality throughout the analysis area as a result of harvest-related traffic are expected to be minor.

- **Gravel Pit Development and Operations**

Under each action alternative, DNRC would develop a gravel pit in Section 24, T23N, R18W. The pit would be up to 22 acres in size and incrementally developed to service gravel needs on the western side of Swan River State Forest. Contractors are required to hold a Montana Air Quality Permit for Portable Sources and abide by air quality regulations set forth by DEQ under this permit. Operators regularly apply water during crushing and loading operations and wet stockpiles in order to reduce particulate emissions.

Direct and indirect effects of the gravel mine are expected to be localized to the southern portion of Section 24. Vegetative barriers adjacent to the gravel pit and abatement measures are expected to greatly limit the dispersion of particulate matter beyond this area. Thus direct and indirect effects to air quality throughout the analysis area as a result of gravel pit development and operations is expected to be minor

- ***Cumulative Effects of No-Action Alternative A to Air Quality***

Cumulative effects to air quality as a result of this alternative would not be expected

- ***Cumulative Effects of Action Alternatives B, C, and D to Air Quality***

Actions on adjacent properties and ongoing DNRC timber sales in the analysis area would continue. Burning, road construction, road maintenance, and gravel crushing and hauling associated with ongoing and foreseeable actions on DNRC, federal, private, and tribal forested lands would produce particulate matter. Existing emission sources from residential wood-burning stoves, private homeowner debris burning, road dust created by recreational activities, and periodic wildland fires would continue. Nearby residential areas and towns within the analysis area would experience reductions in air quality during peak burning periods. All burning activities by major burners would continue to comply with emission levels authorized by DEQ, Montana/Idaho Airshed Group, and EPA.

All above-mentioned emissions in conjunction with expected particulate production from the proposed action would occur at higher levels than currently expected. Providing that dust abatement would be used during dry conditions and gravel operations, half of the harvest operations would occur during frozen and/or wetter conditions, construction activities would be short in duration, and emissions produced from burning would be appropriately controlled and monitored, the cumulative effects to air quality are not expected to exceed EPA and DEQ standards.

INTRODUCTION

Many residents and nonresidents of Montana enjoy recreational opportunities in and around Swan River State Forest. Over 39,000 acres of mostly forested, legally accessible land are available for various recreational activities. This analysis describes the existing environment of recreational uses in the Project Area and surrounding areas and discloses the potential environmental effects the proposed action may have on those uses (*see CHAPTER I – PURPOSE AND NEED*).

ISSUES AND MEASUREMENT CRITERIA

Issues

A number of concerns were raised during the scoping period regarding potential impacts the proposed action may have on recreation throughout the area. The following issue statement accounts for those concerns and ultimately guides this analysis:

> *Activities associated with the proposed action may affect recreational uses in the area and the subsequent revenue generated by such uses. The recreational uses of particular concern include public motorized use, hunting, and other public nonmotorized uses.*

Measurement Criteria

Quantitative and qualitative changes to the following measurement criteria are intended to 'measure' the extent of the potential direct, indirect, and cumulative environmental effects the proposed action may have on existing recreational uses in the area:

- miles of motorized and nonmotorized recreational access;
- big game use of the area;
- amount, duration, and location of forest-management activities in the area; and
- revenue generated from the General Recreational Use, Special Recreational Use, Conservation, and Land Use licenses.

ANALYSIS AREAS

The Project Area will be the analysis area used to determine direct and indirect environmental effects of the proposed action on the recreation resource.

The analysis area used to determine cumulative environmental effects of the proposed action will include all legally accessible state, federal, and private lands within the perimeter of Swan River State Forest and the roads used to access those lands. This analysis area will herein be referred to as the cumulative-effects analysis area.

ANALYSIS METHODS

The methodologies used to portray the existing environment and determine the environmental effects of the proposed action on recreational uses in the project and cumulative-effects analysis areas include determining amounts and types of existing recreational uses, determining the existing condition of each of the measurement criteria, and estimating any changes to the measurement criteria that may result under each alternative. Cumulative effects include consideration of other actions indicated in *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* under *SCOPE OF THIS EIS* in *CHAPTER I - PURPOSE AND NEED*.

DNRC developed the following calculations to determine how many harvest-related traffic trips would result from each action alternative. A 'trip' refers to travel in one direction. That is, a trip *to* the harvest site is counted as one event while the trip *from* the harvest site is counted as a separate event.

- Trips associated with road and harvesting operations = 20 days per month times 9 months of operation per year for 2.5 to 3 years of operation for 4 to 5 vehicles times 2 trips (20 x 9 x [2.5 to 3] x [4 to 5] x 2)
- Trips associated with gravel hauling = 6,000 to 9,000 cubic yards of gravel hauled divided by 12 cubic yards per load times 2 trips ([6,000 to 9,000] / 12 x 2)
- Trips associated with sale administration = 8 to 16 days per month times 9 months of operation per year for 2.5 to 3 years of operation for 1 vehicle times 2 trips ([8 to 16] x 9 x [2.5 to 3] x 1 x 2)
- Trips associated with log hauling = Volume in MMbf divided by 4.5 Mbf, plus 33 percent more trips for cull and pulp material times 2 trips (to and from the site) (MMbf/4.5 Mbf + .33 [MMbf/4.5 Mbf] x 2)
- Trips associated with sale preparation = 12 to 16 days per month times 9 months of marking times 1 to 2 vehicles times 2 trips for 2.5 to 3 years of operations ([12 to 16] x 9 x [1 to 2] x 2 x [2.5 to 3])

RELEVANT AGREEMENTS, LAWS, PLANS, PERMITS, LICENSES, AND OTHER REQUIREMENTS

DNRC RECREATIONAL USE RULES

DNRC Recreational Use Rules (*ARM 36.25.146* through *162*) regulate and provide for the reasonable recreational use of legally accessible school trust lands. Recreational use is divided into 2 categories and, subsequently, requires 2 different types of recreational licenses for those wishing to engage in recreational activities on school trust lands:

1) General Recreational Use License

   General recreational use refers to recreational activities that are nonconcentrated and noncommercial. Examples of these activities include snowmobiling, hiking, bicycling, hunting, motorized use, horseback riding, and berry picking. Any person over the age of 12 who wishes to engage in activities that pertain to general recreational uses is required to obtain a 12-month General Recreational Use License from state license providers DFWP. For recreationists younger than 17 or older than 60, the license is $5. For recreationists between the ages of 17 and 60, the license is $10. All license holders are required to abide by current restrictions, closures, and regulations.

2) Special Recreational Use License

   Special recreational use refers to recreational commercial activities in which an entity charges a participant a fee, specific noncommercial organized group activities, and overnight activities using nondesignated campground areas. Specific examples of such activities include outfitting, noncommercial recreational lodges or retreats, and overnight horse camping. Any person who wishes to engage in activities that pertain to special recreational uses is required to obtain a Special Recreational Use License from DNRC. The cost of the license is determined by DNRC and is assessed at what is considered to be the full market value of that use.

MEMORANDUM OF AGREEMENT AFFECTING RECREATIONAL USE OF STATE SCHOOL TRUST LANDS

This agreement entered into by DFWP and DNRC, requires DFWP to reimburse DNRC $2 for every wildlife conservation license and certain game animal licenses sold in accordance with *MCA 87-2-202, 505, 510,* and *511*.

Land Use License

DNRC Surface Management Rules (*ARM 36.25.102(14)*) define and allow for the use of state lands for uses other than for which the land is classified. Such uses are allowed for a specific fee and a term not to exceed 10 years (*ARM 36.25.106(2)*).

SWAN VALLEY GRIZZLY BEAR CONSERVATION AGREEMENT

As a cooperator of the SVGBCA, DNRC has agreed to a number of mitigations that restrict motorized use of roads in the project and surrounding areas. Recreational motorized road use is limited to those roads that are open year-round and seasonally to the public (this includes wintertime snowmobile access on otherwise restricted roads).

EXISTING ENVIRONMENT

MOTORIZED AND NONMOTORIZED RECREATIONAL ACCESS

The project and cumulative-effects analysis areas both receive moderate recreational use throughout the year by anyone holding a General Recreational Use License. Current uses include berry and mushroom picking, snowmobiling, cross-country skiing, horseback riding, bicycling, fishing, hiking, and hunting. These activities primarily occur on or adjacent to open, seasonally restricted, and closed roads. Over 60 road miles are available for recreational opportunities throughout the Project Area, while 480 miles are available throughout the cumulative-effects analysis area (*TABLE R-1 – RECREATIONAL ROAD ACCESS*).

While only a limited amount of the existing roads are available for motorized activities, all roads throughout both analysis areas are open year-round to nonmotorized activities, including hiking, horseback riding, bicycling, hunting, and other similar activities that do not require a vehicle. Whitetail Road is a nationally recognized mountain bike trail that runs north and south throughout the Project Area. The number of recreationists who use the road as a bike trail is unknown, but since its popularity is widely known, use is likely frequent, especially throughout the summer months.

TABLE R-1 – RECREATIONAL ROAD ACCESS. Existing miles of road open, seasonally restricted, and closed to public motorized access throughout the Project Area and the cumulative-effects analysis area.

ANALYSIS AREA	OPEN YEAR-ROUND TO PUBLIC MOTORIZED ACCESS	SEASONALLY RESTRICTED TO PUBLIC MOTORIZED ACCESS*	CLOSED YEAR-ROUND TO PUBLIC MOTORIZED ACCESS	*TOTALS*
	MILES			
Project area	11	4.6	46.4	62
Cumulative effects[1]	70	10.2	400.5	480.7

**As cooperators of the SVGBCA, DNRC, Plum Creek, and FNF restricts public motorized use on designated seasonally restricted roads during the grizzly bear spring period (April 1 through June 15).*

[1] Total road miles in the cumulative-effects analysis area include road miles in the project area.

BIG GAME USE

As indicated in *EXISTING ENVIRONMENT* and *ENVIRONMENTAL EFFECTS* under *WILDLIFE ANALYSIS*, a number of threatened, sensitive, and other wildlife species persist throughout the area. Of those, big game species are perhaps the most important to many recreationists who use the area. According to the wildlife analyses for this and prior proposed actions, big game species are currently abundant throughout both analysis areas, affording many hunting opportunities.

FOREST-MANAGEMENT ACTIVITIES

A great portion of the land available to recreationists throughout both analysis areas has undergone levels of forest management in the past, is undergoing current forest management, or is expected to be managed at some point in the future. Many recreationists who frequent the area are, therefore, most likely accustomed to forest-management activities and are adept at shifting their use based on the location and duration of those activities.

Activities that may displace recreationists include harvest-related traffic and active harvesting. Displacement of recreationists from areas of active harvesting and traffic likely coincides with the rotational schedule required under the SVGBCA. Under this agreement, subunits are deemed "inactive" for at least a 3-year period, thereby greatly limiting the amount of forest-management activities occurring in the area. By default, these inactive subunits provide recreationists large areas that are relatively free of active harvesting and harvest-related traffic except for occasional administrative uses and small-scale salvage or sanitation sales. Recreationists are free to take part in motorized and nonmotorized activities in active and inactive subunits while abiding by restrictions set forth under the SVGBCA.

REVENUE FROM GENERAL RECREATION USE, SPECIAL RECREATION USE, CONSERVATION, AND LAND USE LICENSES

Recreationists wanting to engage in hunting and fishing activities on state lands must obtain the appropriate game and fishing licenses and a Conservation License, which includes the General Recreational Use License for these activities only. For other general recreational activities you must obtain a General Recreational Use License. Between fiscal year (FY) 2004 and 2007, the sales of General Recreational Use and Conservation licenses generated a gross annual average of $92,314 and $645,920, respectively. Average gross revenue generated from both licenses per acre of state trust lands over the 4-year period was $0.143 per acre. Applying this average to acreages in both the project area and cumulative-effects analysis area, an estimated gross annual average of $1,476.96 and $5,700.77 was generated by each, respectively, between FY 2004 and 2007.

Additional revenue produced from recreation comes from Special Recreational Use and Land Use licenses. For FY 2007, such licenses generated a total of $7,250 for the trust beneficiaries (*TABLE R-2 – SPECIAL RECREATIONAL AND LAND LICENSES*).

ENVIRONMENTAL EFFECTS

- ***Direct and Indirect Effects of No-Action Alternative A to Recreation***

  No appreciable changes to motorized and nonmotorized access, big game use, forest-management activities, or revenue generated by General Recreational Use, Special Recreational Use, Conservation,

TABLE R-2 – SPECIAL RECREATIONAL AND LAND USE LICENSES. Annual revenue generated by Special Recreational Use Licenses and Land Use Licenses in Swan River State Forest for FY 2007.

LICENSE TYPE	NUMBER OF LICENSES ISSUED	REVENUE ($) GENERATED PER LICENSE TYPE	TOTAL REVENUE ($) GENERATED BY LICENSE TYPE
Special Recreational Use License			
Bobcat trapping	1	0	0
Beaver, muskrat, marten, and fisher trapping	1	0	0
Winter mountain lion outfitting	1	1,500	1,500
Spring bear and big game hunting	1	3,500	3,500
Fishing outfitting	6	200	1,200
Land Use License			
Nature trail	1	500	500
Nordic ski trail	1	250	250
Scenic horse rides	1	300	300
Total			*7,250*

and Land Use licenses would occur. Therefore, direct and indirect effects to recreational use and revenue as a result of No-Action Alternative A would not be expected.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Recreation***

While some differences occur in harvest amounts and road miles between the 3 action alternatives, the effects to recreation are expected to be indistinguishable between these alternatives. The only distinguishable difference between alternatives occurs in the location of harvesting activities. Activities associated with Action Alternatives B and D would be spread throughout the Project Area, while those associated with Action Alternative C would be concentrated in the northern portion.

- **Motorized And Nonmotorized Recreational Access**

Under each action alternative, all newly constructed road miles would be closed year-round to public motorized use, yet remain open to public nonmotorized use. Approximately 14 miles of road would be constructed under Action Alternative B, 9.5 miles under C, and 11 miles under D. Thus, the action alternatives would lead to a 15- to 23-percent increase in road miles available for public nonmotorized recreation in the project area.

- **Big Game Use**

According to *EXISTING ENVIRONMENT* and *ENVIRONMENTAL EFFECTS* in *WILDLIFE ANALYSIS*, negative impacts to big game use in the project area are expected to be minor under each action alternative. Therefore, adverse direct and indirect effects to hunting and wildlife-viewing opportunities are expected to be minor as well.

- **Forest-Management Activities**

Under each action alternative, active harvesting and harvest-related traffic would occur up to 9 months per year over the 2.5- to 3-year operating period. Operators would continue to recognize restrictions in place under the SVGBCA and concentrate most management activities outside of the grizzly bear spring period (April 1 through June 15).

Harvesting operations and associated traffic would mostly occur during the typical business workweek (Monday through Friday) and cease each day by early evening except for the occasional operator and use of campgrounds by contractors.

Harvest-related traffic under each action alternative is expected to be considerable, resulting in approximately 5,800 to 8,000 traffic trips per year along designated haul routes (*TABLE R-3 – HARVEST-RELATED TRAFFIC*). Seventy-five to 80 percent of those trips would be completed by large trucks.

Direct and indirect effects to recreational use as a result of forest-management activities are expected to be localized to harvest units and harvest-related roads (*see CHAPTER II – ALTERNATIVES, FIGURE II-1 – ACTION ALTERNATIVE B, FIGURE II-2 – ACTION ALTERNATIVE C,* and *FIGURE II-3 – ACTION ALTERNATIVE D*). Those who choose to recreate in the area during the workweek daytime hours would likely meet harvest-related traffic on designated haul routes and operators in designated harvest units; thus, direct and indirect effects on these recreationists are expected to be moderate to high. Those who choose to recreate in the area on the weekend or during the workweek evenings would likely meet minimal harvest-related traffic and harvesting operations, except for occasional operators; thus, direct and indirect effects to these recreationists are expected to be minimal.

TABLE R-3 – HARVEST-RELATED TRAFFIC. Road and harvesting operations, gravel and log hauling, sale administration, and sale preparation traffic trips by action alternative.

ACTION ALTERNATIVE	HARVEST-RELATED TRIPS					
	ROAD/ HARVESTING OPERATIONS	GRAVEL HAULING	SALE ADMINISTRATION	LOG HAULING	SALE PREPARATION	*TOTALS*
B	4,320 to 5,400	1,000 to 1,500	432 to 864	12,709	648 to 1,728	*19,109 to 22,200*
C	4,320 to 5,400	1,000 to 1,500	432 to 864	14,305	648 to 1,728	*20,705 to 23,797*
D*	3,600 to 4,500	1,000 to 1,500	360 to 720	9,162	540 to 1,440	*14,662 to 17,322*

** Activities under Action Alternative D are expected to last 2.5 years rather than 3 years since the proposed volume is smaller than the other 2 action alternatives; therefore, totals were derived by using 2.5 as a multiplier rather than 3.*

- **Revenue from General Recreational Use, Special Recreational Use, Conservation, and Land Use Licenses**

No changes in revenue produced from General Recreational Use, Special Recreational Use, Conservation, and Land Use licenses are expected to occur under the action alternatives. Forest-management activities in the area may temporarily displace some license holders.

- ***Cumulative Effects of No-Action Alternative A to Recreation***

Cumulative effects to recreational use and revenue would not be expected.

- ***Cumulative Effects of Action Alternative B, C, and D to Recreation***

Foreseeable future road development on adjacent lands in conjunction with that proposed under each action alternative would lead to increases in public nonmotorized access. As required under the SVGBCA, any new road miles built by cooperators would be closed year-round to motorized public access. Ongoing and proposed future actions outside of the proposed action would likely continue on state land and adjacent properties. Traffic increases from those activities in conjunction with those that would occur under each action alternative would temporarily displace recreationists from areas during the workweek. Those who plan to recreate during the weekend would likely meet minimal harvest-related traffic except for occasional weekend operators and homeowners within the area.

Inactive subunits closed to major commercial activities throughout the area would continue to be available for public motorized and nonmotorized use as regulated under the SVGBCA.

Thus, cumulative effects would result in increases in nonmotorized public access and further displacement of recreationists from active harvest areas during typical business hours. Adverse cumulative effects are expected to be minor since recreationists would continue to have recreational opportunities throughout the inactive subunits.

INTRODUCTION

This analysis describes the existing visual quality and noise levels throughout the area and discloses the potential environmental effects the proposed action may have on those attributes.

ISSUES AND MEASUREMENT CRITERIA

Issues

The following issues concerning visual quality and noise levels were raised during internal and external scoping and will be analyzed in further detail in this analysis:

- Activities associated with the proposed action may affect the visual quality as seen from specific observation points within the area.
- Activities associated with the proposed action may affect local noise levels.

Measurement Criteria

Quantitative and qualitative changes to the following measurement criteria are intended to 'measure' the extent of the potential direct, indirect, and cumulative environmental effects the proposed action may have on existing visual quality and noise levels in the area.

- The number of harvest-unit acres and road miles visible from specific observation points.
- The quality of views from specific observation points in terms of texture, form, line, and color as viewed in the foreground, middle ground, and background.
- The magnitude, timing, and type of activities that produce noise within the area.

ANALYSIS AREAS

The analysis area used to determine direct and indirect environmental effects of the proposed action on the visual quality and noise levels will be the Project Area.

The analysis area used to determine cumulative environmental effects of the proposed action on the visual quality and noise levels will include all state, federal, and private lands within the perimeter of Swan River State Forest. This analysis area will herein be referred to as the cumulative-effects analysis area.

ANALYSIS METHODS

VISUAL QUALITY

The methodologies used to portray the existing environment and determine the environmental effects of the proposed action on the visual quality in the project area and cumulative-effects analysis area include using GIS and methods adapted from the Landscape Visibility section of the USFS Scenery Management System (*USFS 1995*).

Using a GIS viewshed analysis and historical harvest data, DNRC calculated past, present, and future DNRC acres of harvest units and miles of road visible and not visible from various observation points for both the existing environment and environmental-effects section of this analysis. Harvest history on adjacent ownerships was not available. Therefore, viewshed analyses were cross-referenced with digital air photos to estimate the amount of land that has been previously harvested on these ownerships and is visible from each observation point.

The following observation points were determined to be important areas of concentrated public-viewing use:

- **Observation Point 1** refers to the existing roads open and seasonally restricted to public motorized use within the Project Area.
- **Observation Point 2** refers to the portion of Highway 83 within the perimeter of the cumulative-effects analysis area.
- **Observation Point 3** refers to viewpoints from high ground and existing structures in the proposed residential development property in Section 13, T23N, R18W.

Acres and road miles visible and not visible from these observation points do not account for existing or potential obstructions in the following visibility ranges: foreground (0 to 0.5 miles), middleground (0.5 to 4.0 miles), and background (4 miles and beyond). Therefore, reported visible acres and road miles are likely to be overestimations of what would be currently or potentially visible from each observation point.

Methods adapted from the USFS Scenery Management System were used to account for obstructions in the visibility ranges and describe existing form, lines, textures, and colors and potential changes to those attributes as proposed under the action alternatives. Harvest units associated with the action alternatives were displayed by prescription type to more accurately disclose the potential visual quality of harvest units expected under each alternative. Road miles were not displayed on any of the figures since only very small segments of new road associated with the project would be visible under each action alternative. These small segments were barely visible in each figure and were thus eliminated.

NOISE LEVELS

The methodologies used to portray the existing environment and to determine the environmental effects of the proposed action on the noise levels in the Project Area and cumulative-effects analysis area include estimating the magnitude, timing, and type of activities that produce noise.

Cumulative-effects analyses for both visual quality and noise levels include consideration of other actions indicated in *RELEVANT PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS* under *SCOPE OF THIS EIS* in *CHAPTER I*.

EXISTING ENVIRONMENT

VISUAL QUALITY

Harvest Units

Data describing forest-management activities on Swan River State Forest date back beyond 1935 and indicate that approximately one-third of DNRC-managed lands have undergone treatment to date. According to the viewshed analysis, 38 to 62 percent of the acres in the project area and 46 to 50 percent of the acres in the cumulative-effects analysis area that are currently visible from each observation point have been harvested in the past (*TABLE A-1 – EXISTING VISUAL ENVIRONMENT- ACRES*). By cross-referencing aerial photos with the viewshed analyses generated for each observation point, about two-thirds of the visible acres was on adjacent properties, as viewed from each observation point, have likely been harvested in the past.

Most visible harvested acres currently occur in the foreground and middleground of each observation point. DNRC, Plum Creek, and FNF are required to provide vegetative visual screening along open roads under the

AESTHETICS ANALYSIS

TABLE VI-1 – EXISTING VISUAL ENVIRONMENT- ACRES. Existing harvested and unharvested acres visible and not visible in the project area and cumulative-effects analysis area by observation point.

MANAGEMENT BY OBSERVATION POINT	ANALYSIS AREAS							
	PROJECT AREA STATE			CUMULATIVE EFFECTS				
				STATE			OTHER OWNERSHIP	
	VISIBLE		NOT VISIBLE	VISIBLE		NOT VISIBLE	VISIBLE	NOT VISIBLE
	ACRES	PERCENT	ACRES	ACRES	PERCENT	ACRES	ACRES	
Observation Point 1								
Harvested	672	41	1,284	1,659	34	12,524	–	–
Unharvested	980	59	3,356	3,274	66	22,313	–	–
Totals	*1,652*	*100*	*4,640*	*4,933*	*100*	*34,837*	*4,480*	*25,579*
Observation Point 2								
Harvested	237	62	1,722	816	31	13,389	–	–
Unharvested	147	38	4,190	1,799	69	23,788	–	–
Totals	*384*	*100*	*5,912*	*2,615*	*100*	*37,177*	*1,928*	*28,130*
Observation Point 3								
Harvested	294	47	1,665	2,116	40	11,843	–	–
Unharvested	335	53	4,001	3,223	60	22,587	–	–
Totals	*629*	*100*	*5,666*	*5,339*	*100*	*34,430*	*4,157*	*25,902*

SVGBCA. As a result, many foreground views along such roads (Observation Points 1 and 2) are inhibited by a barrier of standing trees. According to aerial photo interpretation, foreground views from Observation Point 3 may also be inhibited by existing stands interspersed throughout the section. Depending on visual screening characteristics and topography, harvested stands further away from all 3 observation points may be more visible than those that are nearby.

Due to the evolution of forest-management practices and the diversity of ownerships in both analysis areas, the existing landscape has various modifications of vegetative textures, forms, lines, and colors affecting the visual quality of the area. Hard, distinctive lines exist where different ownerships meet, making for a 'checkerboard' appearance when viewed from the observation points. The historical development of smaller harvest units in some areas has created a relatively patchy-looking landscape. Such characteristics have led to a multitude of different colors dotting the landscape. Areas that have undergone more intensive treatments (i.e., clearcut, seedtree) often appear lighter in color than those that have undergone less intensive treatments (i.e., commercial thinning).

As stands have regenerated, so has the scenic integrity (degree of intactness) of the forested landscape. DNRC-managed stands harvested prior to 1970 have regenerated to the point that they have blended in with adjacent unharvested stands, while stands harvested after 1970 are more evident. These newer stands appear lighter in color and more distinctive in form and have harder perimeter lines. Of the visible DNRC-managed acres harvested in both analysis areas, 50 to 70 percent were harvested after 1970. By comparing DNRC-managed harvest units with those on adjacent ownerships, approximately half of the visible harvested acres on other lands have been harvested in the past 3 decades, thereby, resulting in similar visual qualities as the DNRC-managed stands that have been known to have been harvested after 1970.

Roads

Over 590 miles of open, closed, and seasonally restricted roads occur throughout the cumulative-effects analysis area. Roads introduce hard distinctive lines that are very light-colored in comparison to adjacent forested and harvested areas. According to the viewshed analysis, 7 to 36 percent of the road miles within the Project Area and 7 to 14 percent of the road miles within the cumulative-effects analysis area are currently visible from each observation point (*TABLE A-2 – EXISTING VISUAL ENVIRONMENT – ROADS*). Of the visible road miles, 36 to 50 percent within the Project Area and 20 to 30 percent within the cumulative-effects analysis area are open. As stated earlier, managers are required to provide visual screening along open roads; therefore, views of these roads are likely inhibited by barriers alongside the roadways. Depending on potential visual barriers in the foreground and middleground, restricted roads may be more visible from the observation points.

NOISE LEVELS

Activities that generate noise within the Project Area and cumulative-effects analysis area include:

- traffic associated with harvesting, road building, motorized recreation, and administrative use;
- harvesting operations; and
- rock blasting and gravel crushing.

TABLE A-2 – EXISTING VISUAL ENVIRONMENT- ROADS. Existing road miles visible and not visible within the Project Area and cumulative-effects analysis area by observation point and road type.

ROAD TYPE BY OBSERVATION POINT	ANALYSIS AREAS					
	PROJECT AREA			CUMULATIVE EFFECTS		
	VISIBLE		NOT VISIBLE	VISIBLE		NOT VISIBLE
	MILES	PERCENT	MILES	MILES	PERCENT	MILES
Observation Point 1*						
Open	8.2	36	2.7	16.4	20	64.5
Restricted	14.4	64	37.0	67.0	80	442.6
Totals	*22.6*	*100*	*39.7*	*83.4*	*100*	*507.1*
Observation Point 2						
Open	1.9	50	9.0	12.6	30	68.3
Restricted	1.9	50	49.5	29.1	70	480.5
Totals	*3.8*	*100*	*58.5*	*41.7*	*100*	*548.8*
Observation Point 3						
Open	3.1	40	7.7	16.6	20	66.4
Restricted	4.6	60	46.9	66.5	80	440.6
Totals	*7.7*	*100*	*54.6*	*83.1*	*100*	*507.0*

* *Most of the road miles visible from Observation Point 1 actually occur along the observation point itself (existing open and seasonally restricted roads in the Project Area).*

Noise generation from forest-management activities coincides with the rotational schedule required under the SVGBCA. Under this agreement, subunits are deemed "inactive" for at least a 3-year period, thereby greatly limiting the amount of forest-management activities occurring in the area. By default, these inactive subunits are relatively free of forest-management activities except for occasional administrative use and small-scale salvage or sanitation sales. Currently, the Project Area subsides in a subunit that is inactive until 2009; therefore, noise generated by forest-management activities is relatively infrequent. Noise created by motorized public use continues to be frequent throughout both areas.

ENVIRONMENTAL EFFECTS

- ***Direct and Indirect Effects of No-Action Alternative A to Aesthetics***

  No harvest-related activities would occur; therefore, no direct and indirect effects to visual quality and noise levels would be expected.

- ***Direct and Indirect Effects of Action Alternatives B, C, and D to Aesthetics***

  While there are some differences in amount and quality of visible harvested acres, amount of visible road miles, and noise generation between the 3 action alternatives, the anticipated effects to visual quality and noise levels are expected to be indistinguishable between alternatives. The only distinguishable difference between the alternatives occurs in the location of visible harvest units, visible road miles, and noise levels. Effects associated with Action Alternatives B and D would be spread throughout the Project Area, while most associated with Action Alternative C would be concentrated in the northern portion of the Project Area.

VISUAL QUALITY

Harvest Units

The amount, location, and quality of visible acres would vary by action alternative as viewed from all observation points (*TABLE A-3 – VISUAL ENVIRONMENTAL EFFECTS – ACRES).*

See also *FIGURES A-1 – ACTION ALTERNATIVE B, OBSERVATION POINT 1* through *FIGURE A-9 – ACTION ALTERNATIVE D, OBSERVATION POINT 3*).

Viewers from all observation points would tend to see more harvested acres under Action Alternative B than Action Alternative C or D. Action Alternative B would result in a 30- to 45-percent increase in visible harvested acres in the project area seen from each observation point while Action Alternative C would result in a 23- to 30-percent increase and Action Alternative D would result in a 15- to 24-percent increase. The vast majority of visible harvest units would occur within the foreground and middleground of each observation point. Due to visual barriers mentioned in *EXISTING ENVIRONMENT*, views of harvest units in the immediate foreground would likely continue to be partially obstructed, while views of harvest units in the distance may be more apparent under each action alternative.

Various types of prescriptions associated with each action alternative would result in various types of textures, forms, lines, and colors.

- Seedtree – Seedtree prescriptions

TABLE A-3 –VISUAL ENVIRONMENTAL EFFECTS – ACRES. Proposed harvested acres visible and not visible in the project area and cumulative-effects analysis areas by action alternative and observation point.

ACTION ALTERNATIVE BY OBSERVATION POINT	ANALYSIS AREA			
	PROJECT AREA		CUMULATIVE EFFECTS	
	VISIBLE	NOT VISIBLE	VISIBLE	NOT VISIBLE
	Acres			
Observation Point 1				
B	314	1,219	2,118	15,192
C	207	1,369	2,012	15,341
D	162	1,041	1,967	15,014
Observation Point 2				
B	73	1,463	1,008	16,326
C	55	1,527	990	16,391
D	52	1,156	987	16,008
Observation Point 3				
B	91	1,423	2,547	14,520
C	74	1,487	2,530	14,585
D	45	1,141	2,501	14,239

would result in stands with approximately 15-percent canopy cover. Stands undergoing this type of treatment are expected to appear very light in color, distinctive in form, and have hard perimeter lines where the stand meets adjacent regenerating or unharvested stands. Approximately 6 to 8 of the largest available trees per acre would be left along with varying amounts of small submerchantable trees. Seedtree stands would be most apparent compared to the other prescription types.

- Seedtree with reserves – Seedtree with reserves prescriptions would result in similar conditions to stands treated with seedtree prescriptions except that one or more patches of approximately 1.6 acres in size would be interspersed throughout the stand. Such patches would contribute to patchiness and color variations of the stand.
- Shelterwood – Shelterwood prescriptions would result in stands with approximately 22-percent canopy cover. Stands undergoing this type of treatment are expected to have similar qualities to those of seedtree stands, only to a lesser degree. Approximately 12 to 16 trees per acre would be left along with varying amounts of small submerchantable trees. These stands would be only slightly less apparent than seedtree stands.
- Shelterwood with reserves – Shelterwood with reserves prescriptions would result in similar conditions to stands treated with shelterwood prescriptions, except one or more patches of approximately 1.6 acres in size would be interspersed

throughout the stand.

- Variable thinning – Variable thinning prescriptions would result in stands with approximately 40-percent canopy cover. Stands undergoing this type of treatment are expected to be darker in color, less distinctive in form, and have softer perimeter lines than stands undergoing any of the above-mentioned prescriptions.

Most visible acres from the observation points would be treated with seedtree, seedtree with reserves, shelterwood, and shelterwood with reserves prescriptions. As described above, these prescriptions are expected to result in stand conditions that appear relatively stark in contrast when adjacent to regenerating or unharvested stands. When feasible, these lines would be 'softened' by tapering or feathering stand perimeters and rounding hard stand corners. Over time, these stands are expected to become less apparent and darker in color, thereby blending with adjacent unharvested and regenerating stands within the Project Area.

Gravel-pit acres visible from the observation points would be developed incrementally over time. Vegetative barriers existing adjacent to the gravel pit are expected to inhibit visibility from all observation points.

Roads

Of the new road miles proposed under each alternative, approximately 1 percent would be visible from each observation point (*TABLE A-4 – VISUAL ENVIRONMENTAL EFFECTS – ROADS*).

Visible road miles from each observation point would be broken up into 2 to 12 small segments and scattered throughout the Project Area. All new road miles would be managed as restricted or closed roads; therefore, visual screening requirements would not apply. Depending on topography and visual barriers in the foreground and middleground, some small road segments may be visible from the observation points. Since the increase in visible road miles would be relatively small, direct and indirect effects to visual quality as a result of new road segments associated with the action alternatives are expected to be minor.

NOISE LEVELS

Under each action alternative, noise would be generated by harvesting operations, harvest-related traffic, road construction, and gravel-pit development, including rock blasting and gravel crushing.

Under each action alternative, harvesting activities, harvest-related traffic, road construction, and gravel pit development would occur up to 9 months per year over the 2.5- to 3-year operating period. Operators would continue to recognize restrictions in place under the SVGBCA and concentrate most management activities outside of the grizzly bear spring period (April 1 through June 15).

Activities would mostly occur during the typical business workweek (Monday through Friday) and cease each day by early evening except for occasional operators and use of the campgrounds by contractors.

TABLE A-4 –VISUAL ENVIRONMENTAL EFFECTS – ROADS.** **Proposed road miles visible and not visible within the Project Area and cumulative-effects analysis area by action alternative and observation point.

ACTION ALTERNATIVE BY OBSERVATION POINT	ANALYSIS AREAS			
	PROJECT AREA		CUMULATIVE EFFECTS	
	VISIBLE	NOT VISIBLE	VISIBLE	NOT VISIBLE
	Miles			
Observation Point 1				
B	1.2	12.8	84.6	519.9
C	0.8	8.7	84.2	515.8
D	0.5	10.6	83.9	517.7
Observation Point 2				
B	0.2	13.8	41.9	562.6
C	0.5	9.1	42.2	557.9
D	0.2	10.9	41.9	559.7
Observation Point 3				
B	1.0	13.0	84.1	520.0
C	0.0	9.5	83.1	516.6
D	0.6	10.5	83.7	517.5

According to *RECREATION ANALYSIS* in *CHAPTER III*, approximately 5,800 to 8,000 harvest-related trips would be expected to occur per year over the 2.5- to 3-year operating period along designated haul routes (see *RECREATION ANALYSIS, TABLE R-3 – HARVEST-RELATED TRAFFIC*). Traffic associated with gravel hauling, road and harvesting operations, and log hauling is expected to be louder than the other harvest-related traffic. This louder traffic would constitute 75 to 80 percent of the traffic trips expected under each action alternative.

The 22-acre gravel pit would be developed incrementally over time (5 acres at a time) and coincide with gravel needs for ongoing road construction and maintenance work. Rock blasting and gravel crushing would produce high levels of noise.

Direct and indirect effects to noise levels as a result of harvesting operations, harvest-related traffic, and gravel pit development associated with the action alternatives are expected to be moderate during the workweek and minor during the weekend.

- ***Cumulative Effects of No-Action Alternative A to Aesthetics***

No harvest-related activities would occur; therefore, no cumulative effects to visual quality and noise levels would be expected.

- ***Cumulative Effects of Action Alternatives B, C, and D to Aesthetics***

Current and foreseeable scheduled activities on DNRC-managed and adjacent properties would continue. These activities, in conjunction with those proposed under each action alternative, would result in an increase of total harvested acres and road miles visible from each observation point and an increase in noise levels.

The contribution of visible harvested acres under each alternative as seen from each observation point would be minor in comparison to what exists currently throughout the landscape (*TABLE A-3 – VISUAL ENVIRONMENTAL EFFECTS – ACRES* and *TABLE A-4 – VISUAL ENVIRONMENTAL EFFECTS – ROADS*). Visual barriers along open roads and throughout residential properties would continue to be in place, thereby obstructing foreground views from the observation points. Depending on type and amount of forest management planned on adjacent land ownerships, lands throughout the cumulative-effects analysis area would likely continue to experience similar forms, lines, textures, and colors. Older harvest units would continue to regenerate, blending in line, texture, form, and color, while newer harvest units would continue to introduce new attributes in sharper contrast to regenerating stands.

Except during periods of rock blasting and gravel crushing, cumulative effects to noise would not be expected to increase beyond current levels found within the cumulative-effects analysis area. Rather, noise generated by forest-management activities would be concentrated in the Porcupine/Woodward Grizzly Bear Subunit during the active period of 2009 to 2012. Noise generated by motorized public use would continue throughout the area on designated roads.

FIGURE A-1 – ACTION ALTERNATIVE B, OBSERVATION POINT 1. Action Alternative B proposed harvest unit and gravel pit acres visible and not visible in the project area from Observation Point 1.

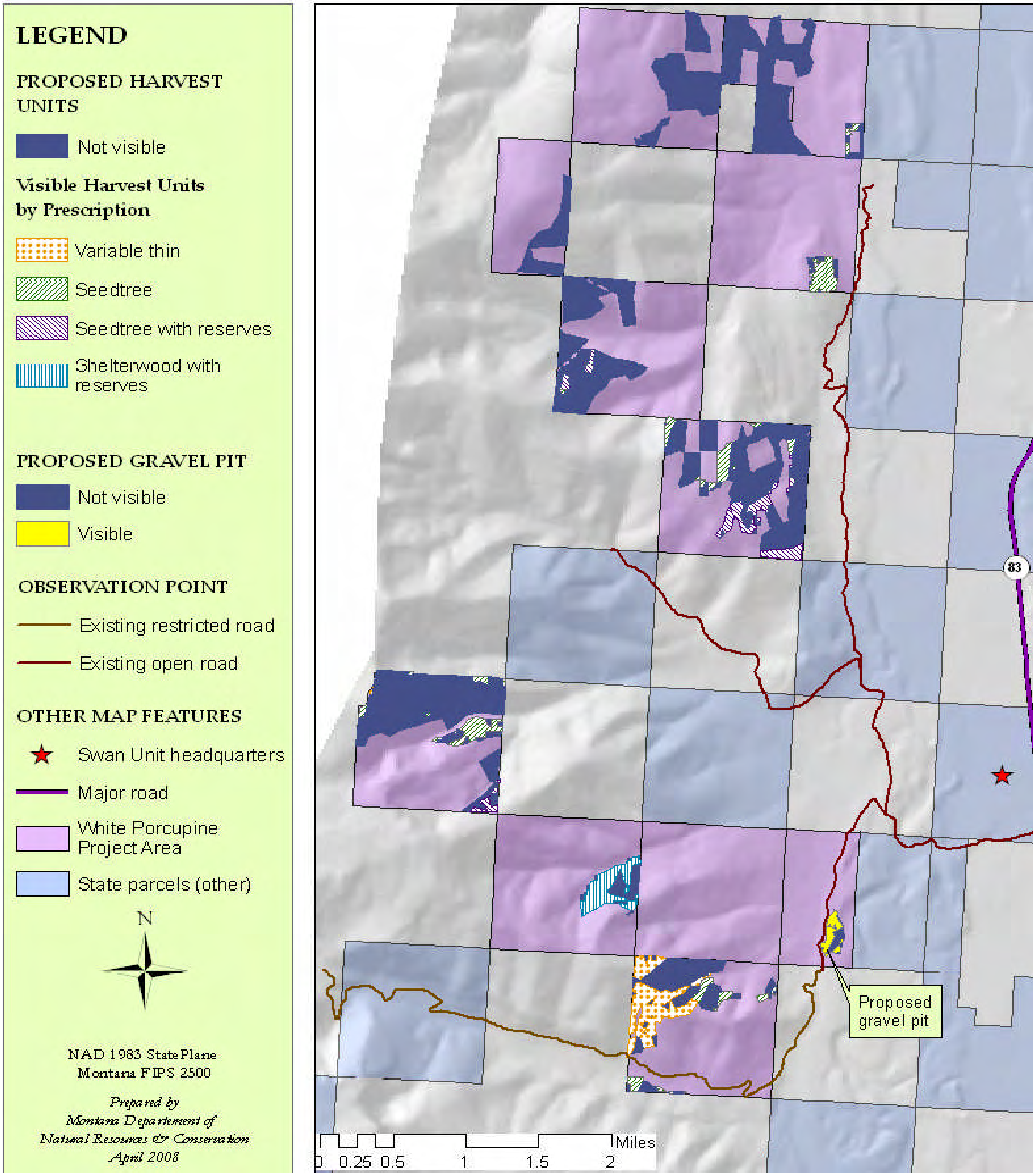


FIGURE A-2 –ACTION ALTERNATIVE C, OBSERVATION POINT 1. Action Alternative C proposed harvest unit and gravel pit acres visible and not visible in the project area from Observation Point 1.

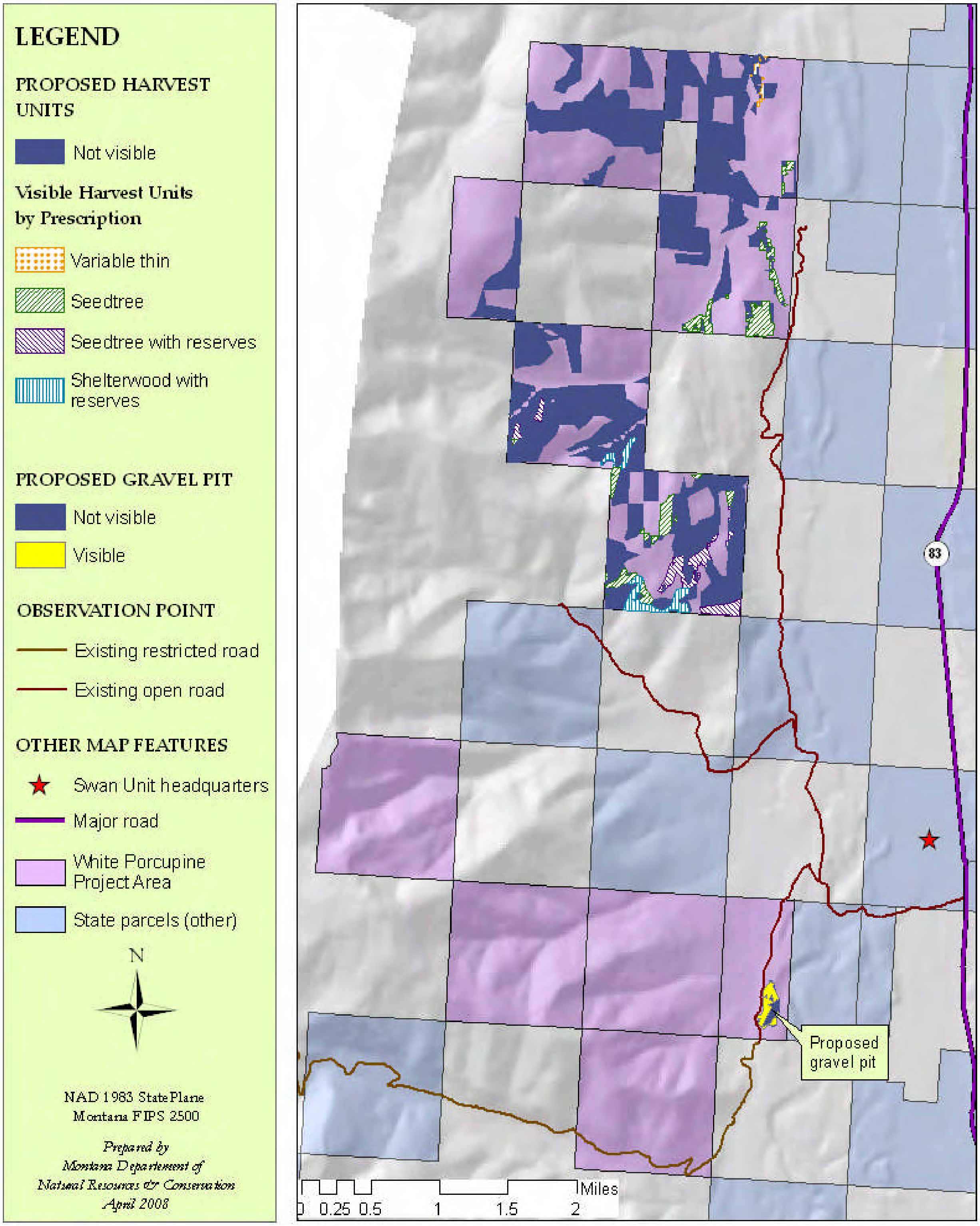


FIGURE A-3 – ACTION ALTERNATIVE D, OBSERVATION POINT 1. Action Alternative D proposed harvest unit and gravel pit acres visible and not visible in the project area from Observation Point 1.

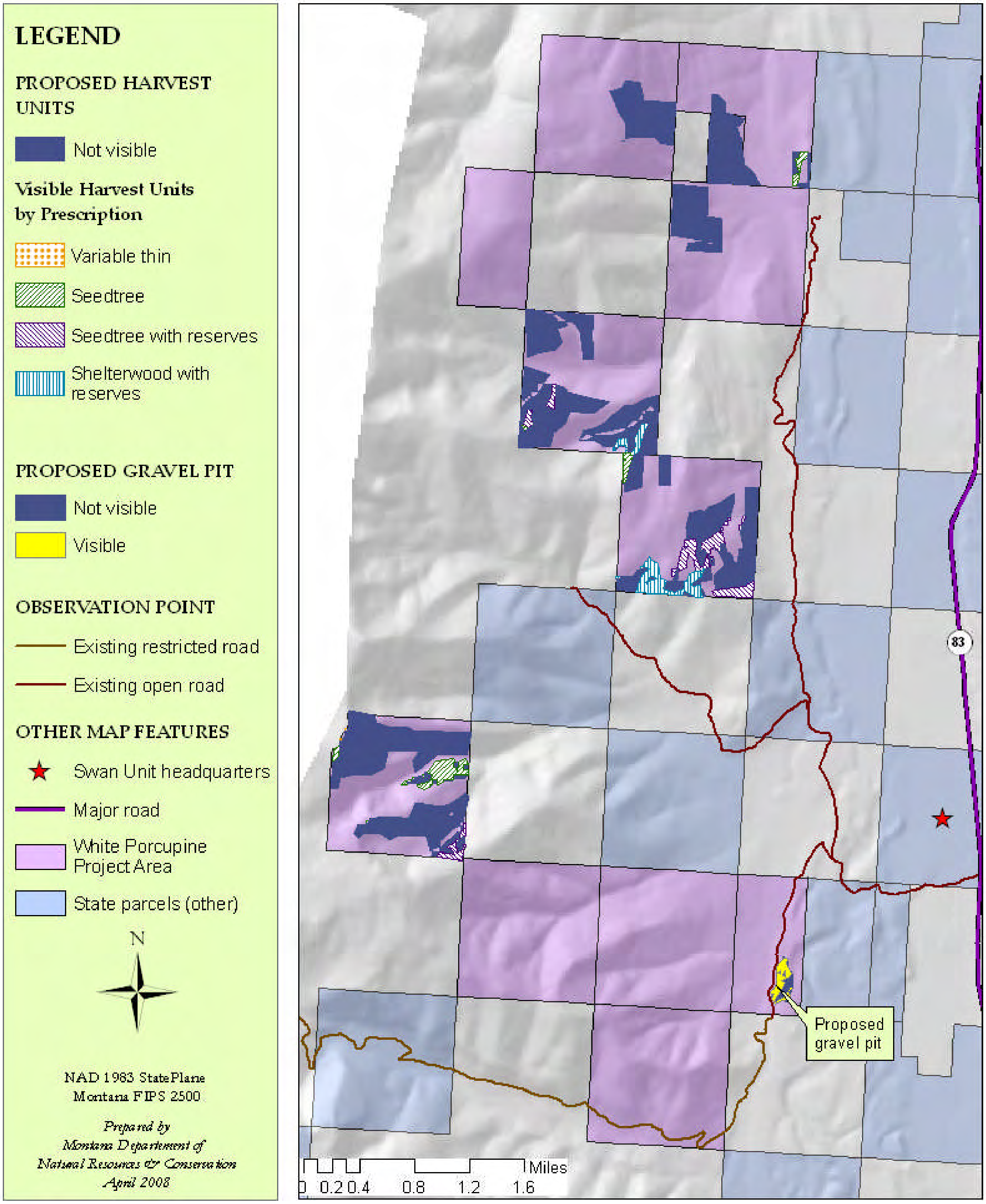


FIGURE A-4 – ACTION ALTERNATIVE B, OBSERVATION POINT 2. Action Alternative B proposed harvest unit and gravel pit acres visible and not visible in the project area from Observation Point 2.

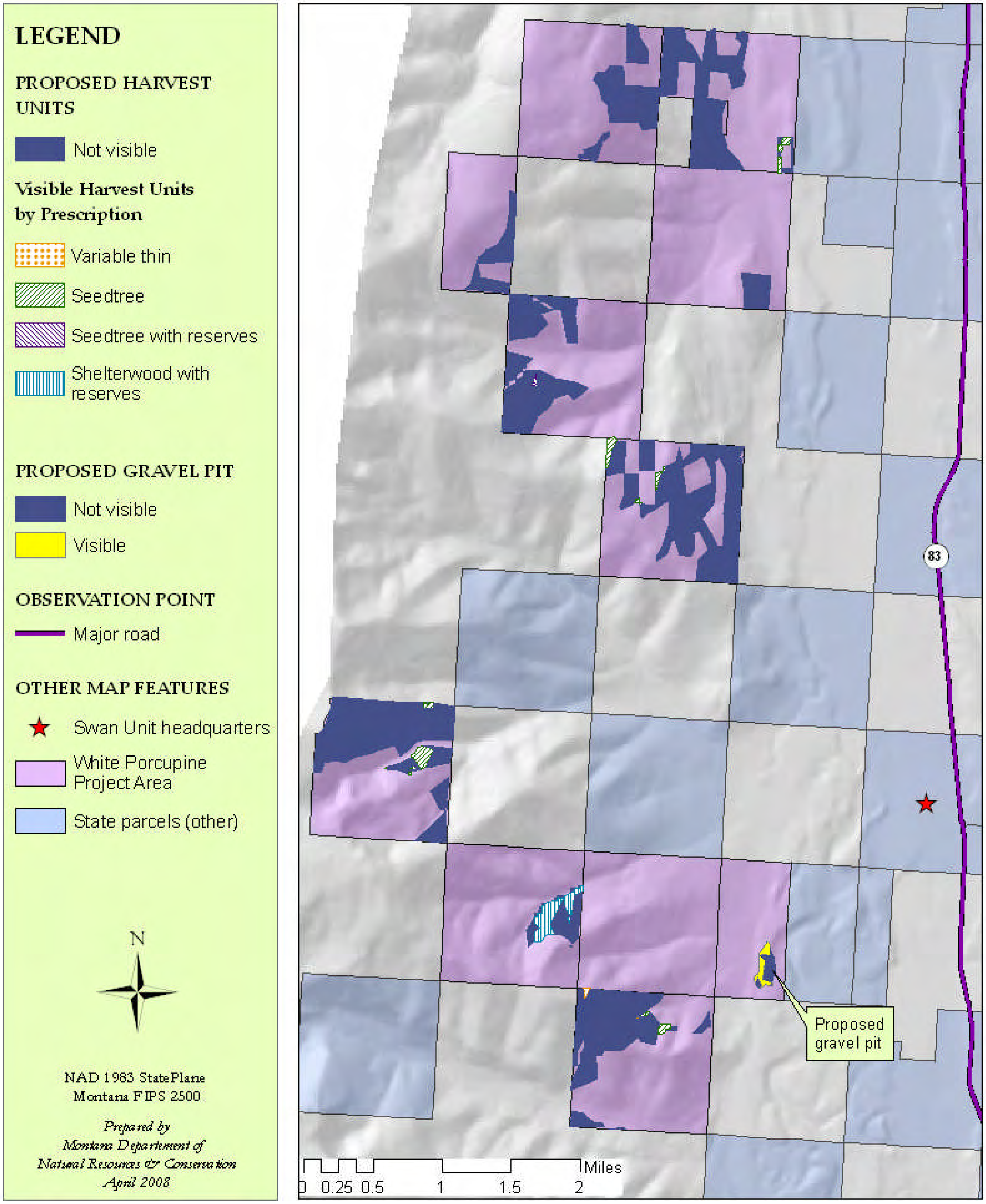


FIGURE A-5 – ACTION ALTERNATIVE C, OBSERVATION POINT 2. Action Alternative C proposed harvest unit and gravel pit acres visible and not visible in the project area from Observation Point 2.

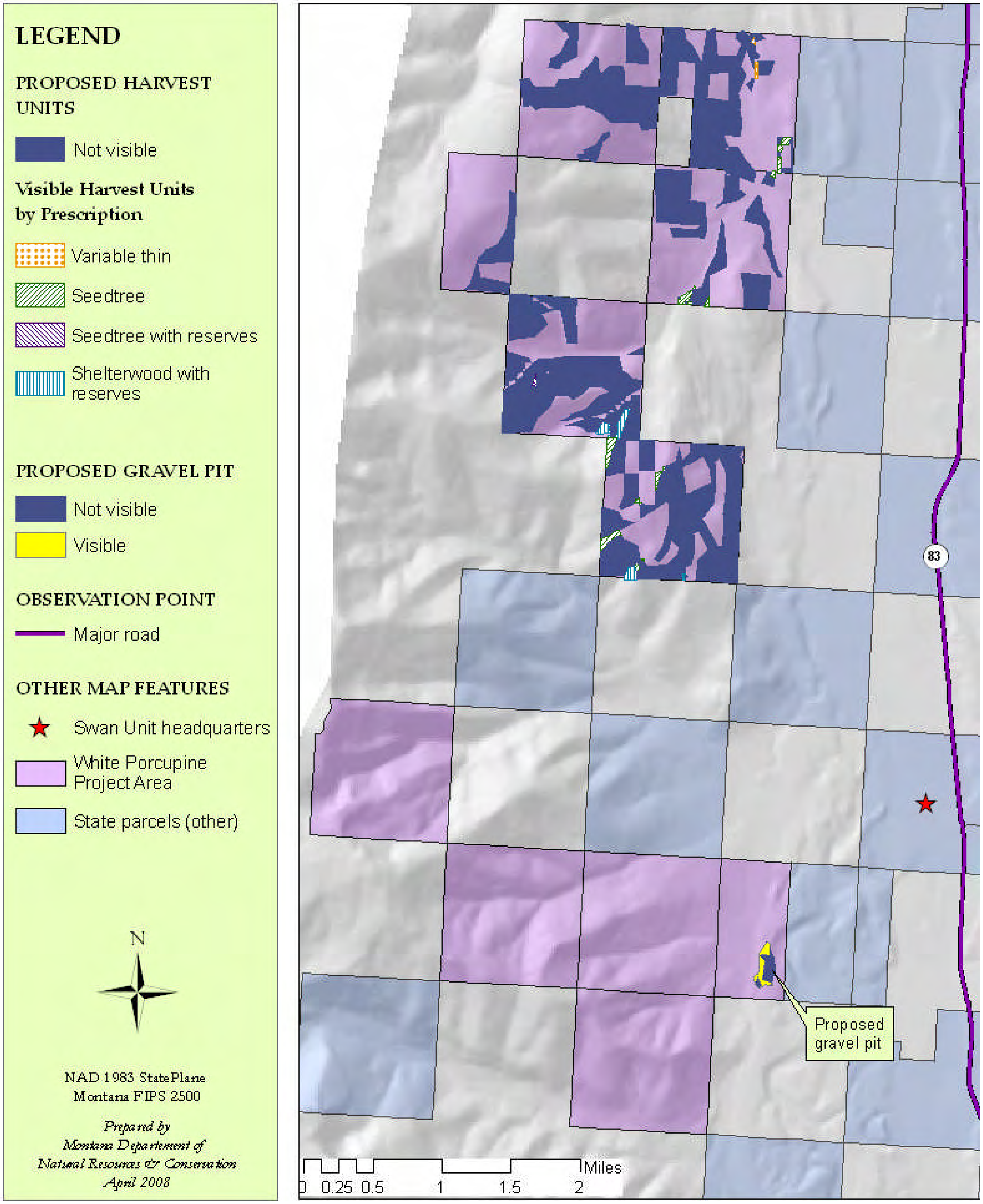


FIGURE A-6 – ACTION ALTERNATIVE D, OBSERVATION POINT 2. Action Alternative D proposed harvest unit and gravel pit acres visible and not visible in the project area from Observation Point 2.

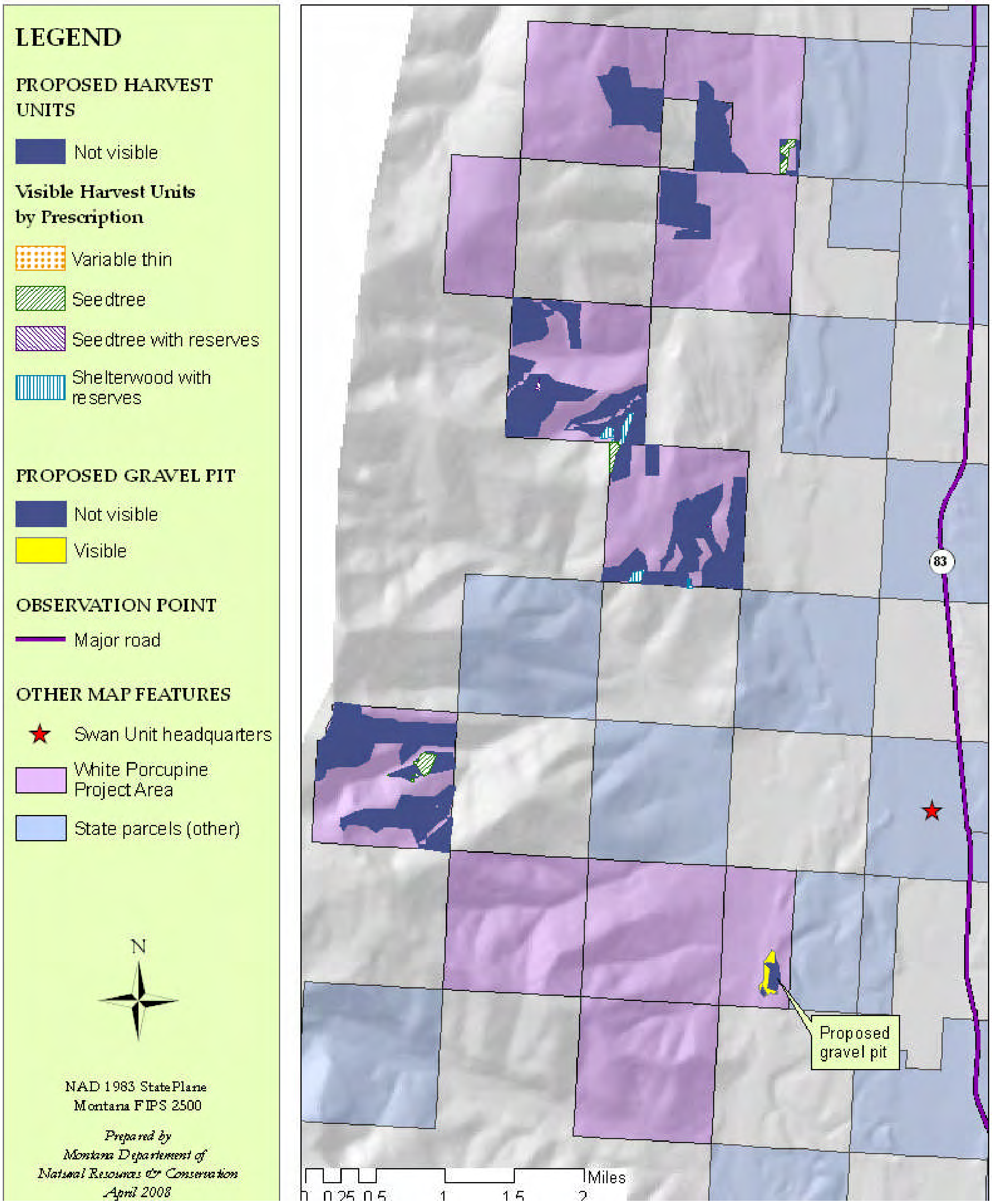


FIGURE A-7 – ACTION ALTERNATIVE B, OBSERVATION POINT 3. Action Alternative B proposed harvest unit and gravel pit acres visible and not visible in the project area from Observation Point 3.

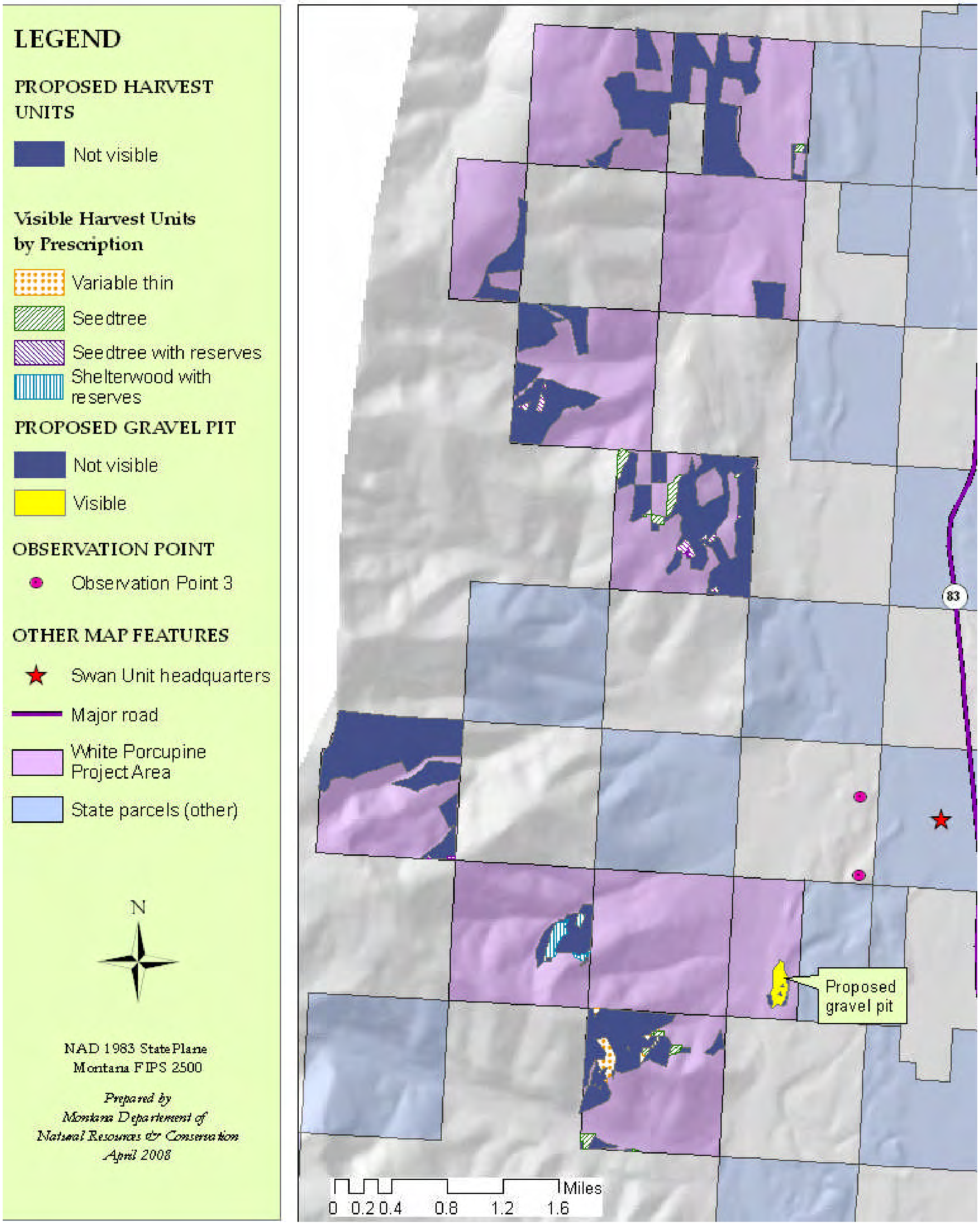
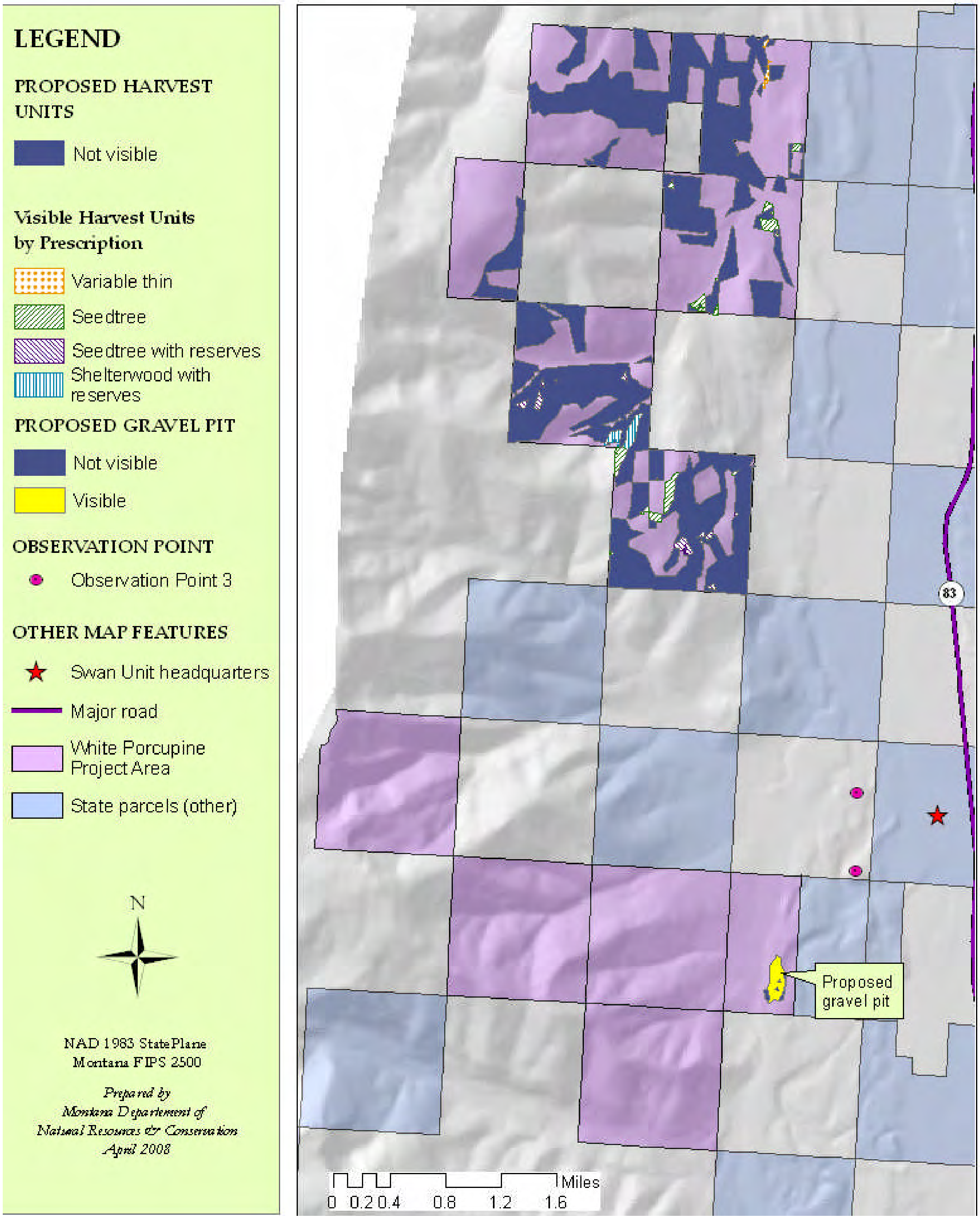
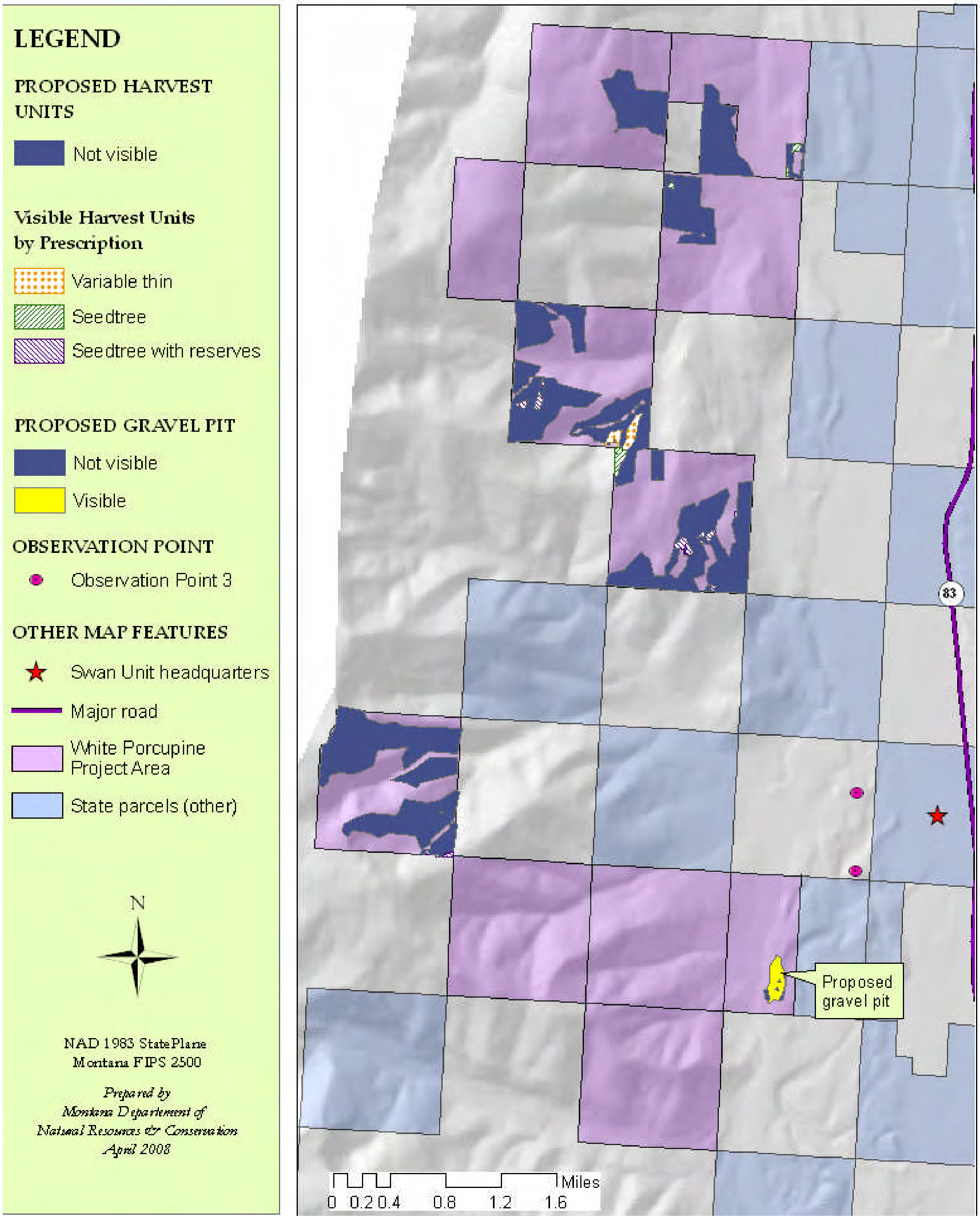


FIGURE A-8 – ACTION ALTERNATIVE C, OBSERVATION POINT 3. Action Alternative C proposed harvest unit and gravel pit acres visible and not visible in the project area from Observation Point 3.



FIGFIGURE A-9 – ACTION ALTERNATIVE D, OBSERVATION POINT 3. Action Alternative D proposed harvest unit and gravel pit acres visible and not visible in the project area from Observation Point 3.



IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF NATURAL RESOURCES

IRRETRIEVABLE

A resource that has been irretrievably committed is lost for a period of time. Many timber stands in the project area are mature; some individual trees are more than 150 years old. Any of the timber-harvesting alternatives would cause live trees to be irretrievably lost; they would no longer contribute to future snag recruitment, stand structure and compositional diversity, aesthetics, wildlife habitat, the nutrient-recycling process, or any other important ecosystem functions.

Areas converted from timber production to permanent roads would be lost from timber production and would not function as forested lands for a period of time.

IRREVERSIBLE

A resource that has been irreversibly committed cannot be reversed or replaced. The initial loss of trees due to timber harvesting would not be irreversible. Natural regeneration combined with site preparation and artificial regeneration would promote the establishment of new trees. If management decisions allowed for the continued growth of established trees, they would ultimately become equivalent in size to the irretrievably harvested trees.

Areas that are initially lost to timber production through road construction could, over time, be reclaimed and once again produce timber and function as forested land.

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STIPULATIONS AND SPECIFICATIONS

The stipulations and specifications for the action alternatives were identified or designed to prevent or reduce the potential effects to the resources considered in this analysis. These measures are derived from issues raised internally and by the public, Forest Management Rules, and other requirements with which forest-management activities must comply, as listed under *RELEVANT AGREEMENTS, LAWS, PLANS, PERMITS, LICENSES, AND OTHER REQUIREMENTS* in *CHAPTER I*.

Stipulations and specifications that apply to harvesting or road-building operations are incorporated into the Timber Sale Contract. As such, they are binding and enforceable. Project administrators will enforce stipulations and specifications relating to activities that may occur during or after the contract period, such as site preparation or hazard reduction.

The following stipulations and specifications will be incorporated to mitigate effects on the resources involved with the action alternatives considered in this proposal. Each section is organized by resource.

VEGETATION

➢ ***SENSITIVE PLANTS***

Appropriate measures will prevent the disturbance of sensitive plant populations. Riparian areas near harvest units will be marked to protect SMZs and isolated wetlands. No harvesting will take place in wetlands or near springs on localized features. If sensitive plant populations are found, the appropriate habitat area will be excluded from the harvest units.

➢ ***NOXIOUS WEED MANAGEMENT***

To further limit the possibility of spreading noxious weeds, the following weed-management mitigation measures will be implemented:

- All tracked and wheeled equipment will be cleaned of noxious weeds prior to beginning project operations. The contract administrator will inspect equipment periodically during project implementation.
- Surface blading on roads affected by the proposal may result in required weed removal before the seed-set stage.
- Disturbed roadside sites will be promptly reseeded. Roads used and closed as part of this proposal will be reshaped and seeded.
- Herbicide application, as designated by the forest officer, may be used to control weeds along roads that access the timber sale area. To reduce risks to aquatic and terrestrial resources, the following will be required:
  - All herbicides will be applied by licensed applicators in accordance with laws, rules, and regulations of the State of Montana and Lake County Weed District.
  - All applications will adhere to BMPs and the herbicides' specific label guidelines.
  - Herbicide applications will not be general, but site-specific to areas along roads where noxious weeds grow. No-spray areas will be

designated on the ground before applications begin.

- Herbicides will not be applied to areas where relief may contribute runoff directly into surface water.
- Herbicides will be applied on calm days free of rain to limit drift and the possibility of the herbicide moving off the road prisms.

WATERSHED AND FISHERIES

- Planned erosion-control measures and BMPs include:
  - installing grade breaks on roads,
  - installing water-diverting mechanisms on roads,
  - installing slash-filter windrows, and
  - grass seeding.
- All road-stream crossings will be monitored for sedimentation and the deterioration of the road prism.
- Equipment traffic will be allowed at road-stream crossings only where road prisms have an adequate load-bearing capacity.
- Culvert sizing for all road projects will be as recommended by the DNRC hydrologist for a 50-year-flood period.
- Stream crossings, where culvert or bridge removals and installations are planned, will have the following requirements, as needed, to meet the intent of water-quality permits and BMPs and protect water quality:
  - diversion channels will be constructed and lined with plastic to divert streamflow prior to any in-channel operations,
  - slash-filter windrows will be constructed on the base of fillslopes,
  - silt fences will be installed along the streambanks prior to and following excavation at crossing sites,
  - filter-fabric fences will be in place downstream prior to and during culvert installation, and
  - bridge work within stream areas will be limited to the period of July 15 through August 31.
- Brush will be removed from existing road prisms to allow effective maintenance. Improved road maintenance will reduce sediment delivery.
- The contractor will be responsible for the immediate cleanup of any spills that may affect water quality (fuel, oil, dirt, etc.).
- Equipment that is leaking fluids will not be permitted to operate in stream-crossing construction sites.
- Included in the project proposal are the following pertinent recommendations of the Flathead Basin Forest Practices, Water Quality and Fisheries Cooperative Program Final Report, June 1991. (The following numbers correspond to the numbering of recommendation items contained within the aforementioned document, included in pages 154 through 162 of the Final Report.)

  1. BMPs are incorporated into the project design and operations.
  2. Riparian indicators would be considered in the harvest unit layout.
  3. Management standards of the SMZ Law (75-5-301 MCA) are used in conjunction with the recommendations of the study.

4. The BMP audit process will continue. This sale would likely be reviewed in an internal audit and may be randomly chosen as a Statewide audit site.

7. SMZs will be evaluated as a part of the audit process.

12. Watershed-level planning and analysis are completed. Logging plans of other agencies and private companies are used.

14. DNRC is cooperating with DFWP on the further study of fish habitat and populations for Whitetail, Main Woodward, and South Woodward creeks.

15. DNRC would use the best available methods for logging and road building for this project.

16A. Existing roads are fully utilized for this proposal.

16B. DNRC utilizes BMPs, transportation planning, and logging system design to minimize new road construction.

17. DNRC contracts with DFWP to obtain species composition, spawning inventory, and spawning habitat quality. DNRC's mitigation plan for roads fits all recommendations for "impaired streams". Using "worst-case scenario" criteria provides for conservative operations in this proposal.

18. Provisions that address BMPs are in the Timber Sale Contract, which are rigidly enforced.

20. Long-term monitoring is planned for Main Woodward and South Woodward creeks, as well as other streams on Swan River State Forest.

29-34. DNRC has cooperated with DFWP to continue fisheries work. DNRC would continue to monitor fisheries in the future as funding allows.

- SMZs and RMZs will be defined along those streams that are within or adjacent to harvest units, and all applicable BMPs and the Rules for fisheries Riparian Management Zones to fish-bearing streams will be followed.
- For the major streams (Whitetail, Main Woodward, South Woodward creeks), a 300-foot buffer (150 feet on each side of the stream) will be maintained in areas where harvesting takes place on both sides of the stream. In areas where harvesting takes place on one side of a major stream, a 150-foot buffer will be maintained on the harvest side if a closed canopy of, at least, pole-sized timber is not present on the other side of the stream. In areas where harvesting takes place on one side of a major stream and a closed canopy of pole-sized timber or larger is present, a 100-foot buffer will be maintained on the harvest side.
- The SMZ law and Rules will be applied to all non-fish-bearing streams in the project area.
- McNeil core and substrate scores will be monitored in bull trout spawning reaches in Main Woodward and South Woodward creeks.
- Stream temperature will be monitored in Whitetail Creek.

WILDLIFE

THREATENED AND ENDANGERED SPECIES

- **Grizzly Bears**
  - All action alternatives will comply with the SVGBCA.
  - Roads and landings will be seeded to revegetate with species less palatable to grizzly bears to minimize the potential for bear-human conflicts.
  - Garbage will be hauled or stored in a safe place so bears will not be attracted to the area.
  - No logging camps will be allowed in the sale area.
  - The Forest Officer will immediately suspend activities directly related to the project to prevent imminent confrontation or conflict between humans and grizzly bears, or other threatened or endangered species.
  - Contractors are prohibited from carrying firearms onto closed roads while working under contract.
  - Where regeneration harvests are proposed along open roads, vegetation screening will be retained within a 100-foot buffer.
  - Where regeneration harvests are proposed, no point in the harvest unit will exceed 600 feet to cover.
- **Gray Wolves**

  A provision will be included in the Timber Sale Contract to protect wolf dens or rendezvous sites in the gross sale area that are discovered during implementation of the project.

BIG GAME

- The purchaser will be authorized to enter the project area with motorized vehicles for only activities related to the performance of the Timber Sale Contract. Road use is restricted to nonmotorized transportation behind road closures for any other purpose. Motorized vehicle entry for purposes other than contract performance, such as hunting or transporting game animals, will be considered in trespass and prosecuted to the fullest extent of law (*ARM 45-6-203*).

  Wildlife Trees and Snag Retention and Recruitment

  - Wildlife trees of high quality, such as large broken-topped western larch, will be designated for retention and given special consideration during yarding operations to prevent loss.
  - Snag retention and recruitment— all cull snags that are safe to operate near and a minimum of 2 snags greater than 21 inches dbh are to be retained. If enough large snags are not present, the balance will be made up from the next largest size class available.
  - Retained snags that need to be felled for operational or safety reasons will be left on site.

SOILS

- ***COMPACTION***
  - Logging equipment will not operate off forest roads unless:
    - soil moisture is less than 20 percent,
    - soil is frozen to a depth of 4 inches or a depth that will support machine operations (whichever is greater), or

- soil is snow-covered to a depth of 18 inches or a depth that will prevent compaction, rutting, or displacement (whichever is greater).

- Existing skid trails and landings will be used when their design is consistent with prescribed treatments and current BMP guidelines are met.
- The harvest project foreman and sale administrator will agree to a skidding plan prior to operating equipment.
- To reduce the number of skid trails and the potential for erosion, designated skid trails will be required where moist soils or short steep pitches (less than 300 feet) will not allow access by other logging systems.
- The density of skid trails in a harvest area will not exceed 20 percent of the total area in the cutting unit.

➢ ***SOIL DISPLACEMENT***

- Conventional ground-based skidding equipment will not be operated on slopes steeper than 40 percent. Soft-tracked yarders are suitable on slopes up to 55 percent. Cable yarding will be used on sustained steeper slopes.
- Slash piling and scarification will be completed with a dozer where slopes are gentle enough to permit (less than 35 percent). Slash treatment and site preparation will be done with an excavator in areas where soils are wet or slopes are steeper (up to 55 percent). Broadcast burning may also be utilized.

➢ ***EROSION***

- Ground-skidding machinery will be equipped with a winchline to limit equipment operation on steeper slopes.
- Roads used by the purchaser will be reshaped and the ditches redefined to reduce surface erosion prior to and following use.
- Drain dips, open-topped culverts, and gravel will be installed on roads as needed to improve road drainage and reduce erosion and maintenance needs.
- Some road sections will be repaired to upgrade the roads to design standards that will reduce the potential for erosion and maintenance needs.
- Certified weed-free grass seed and fertilizer will be applied promptly to newly constructed road surfaces, cutslopes, and fillslopes. These applications will also be done on existing disturbed cutslopes, fillslopes, and landings immediately adjacent to open roads. These applications, which will stabilize soils and reduce or prevent the establishment of noxious weeds, would include:
  - seeding all road cuts and fills concurrent with construction,
  - applying "quick cover" seed mix within 1 day of work completion at culvert-installation sites, and
  - seeding all road surfaces and reseeding culvert installation sites when the final blading is completed for each specified road segment.
- Based on ground and weather conditions and as directed by the forest officer, water bars, logging-slash barriers, and, in some cases, temporary culverts will be installed on skid trails where erosion is anticipated. These erosion-control features would be periodically inspected and maintained

throughout the Contract period or extensions thereof.

AIR QUALITY

- To prevent individual or cumulative effects and provide for burning during acceptable ventilation and dispersion conditions during burning operations, burning will be done in compliance with the Montana Idaho Airshed Group reporting regulations and any burning restrictions imposed in Airshed 2.
- Excavator, landing, and roadwork debris will be piled clean to allow easy ignition during fall and spring when ventilation is good and surrounding fuels are wet. The Forest Officer may require that piles be covered to reduce dispersed (unentrained) smoke and allow the piles to ignite more easily, burn hotter, and extinguish more quickly.
- The number of piles to burn will be reduced by leaving large woody debris in the harvest units.
- Depending on the season of harvest and level of public traffic, dust abatement may be applied on some segments of the roads that will be used during hauling.

AESTHETICS

- Damaged submerchantable residual vegetation will be slashed.
- Landings will be limited in size and number and located away from main roads when possible.
- Disturbed sites directly adjacent to roads will be grass seeded.
- When possible, healthy trees not big enough to be harvested will be retained.
- Techniques such as feathering, which involves marking additional timber along the harvest boundary lines, or rounding, which involves eliminating abrupt edges such as those found at property corners, will be implemented to reduce the appearance of straight harvest unit boundary lines.

CULTURAL RESOURCES AND ARCHAEOLOGY

- A review of the project area was conducted by a DNRC archaeologist and local Native American tribal organizations.
- A contract clause provides for suspending operations if cultural resources are discovered and only resuming operations when directed by the Forest Officer.

ROADS

- Information about road-reconstruction activities and road use associated with road-construction activities will be relayed to the general public.
- Signs will be placed on restricted roads to prohibit public access while harvesting operations are in progress; these roads will be physically restricted during inactive periods (nights, weekends, holidays, shutdowns).
- BMPs will be incorporated into all planned road construction.

GLOSSARY

Acre-foot
A measure of water or sediment volume equal to an amount of material that would cover 1 acre to a depth of 1 foot.

Action alternative
One of several ways of moving toward the project objectives.

Adfluvial
A fish that out migrates to a lake as a juvenile to sexually mature and returns to natal stream to spawn.

Administrative road use
Road use that is restricted to DNRC personnel and contractors for purposes such as monitoring, forest improvement, fire control, hazard reduction, etc.

Airshed
An area defined by a certain set of air conditions; typically a mountain valley where air movement is constrained by natural conditions such as topography.

Ameliorate
To make better; improve.

Appropriate conditions
Describes the set of forest conditions determined by DNRC to best meet the SFLMP objectives. The 4 main components useful for describing an appropriate mix of conditions are cover-type proportions, age-class distributions, stand-structure characteristics, and the spatial relationships of stands (size, shape, location, etc.); all are assessed across the landscape.

Background view
Views of distant horizons, mountain ranges, or valleys from roads or trails.

Best Management Practices (BMPs)
Guidelines to direct forest activities, such as logging and road construction, for the protection of soils and water quality.

Biodiversity
The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems where they occur.

Board foot
144 cubic inches of wood that is equivalent to a piece of lumber 1-inch thick by 1 foot wide by 1 foot long.

Canopy
The upper level of a forest consisting of branches and leaves of the taller trees.

Canopy closure
The percentage of a given area covered by the crowns, or canopies, of trees.

Cation exchange capacity
The capacity of a soil for ion exchange of positively charged ions between the soil and the soil solution. Cation exchange capacity is used as a measure of soil fertility, nutrient retention capacity, and the capacity to protect groundwater from cation contamination.

Cavity
A hollow excavated in trees by birds or other animals. Cavities are used for roosting and reproduction by many birds and mammals.

Centimeter
A distance equal to .3937 inch.

Commercial-thin harvesting
A harvest that cuts a portion of the merchantable trees within a stand to provide growing space for the trees that are retained.

Compaction
The increase in soil density caused by force exerted at the soil surface, modifying aeration and nutrient availability.

Connectivity
The quality, extent, or state of being joined; unity; the opposite of fragmentation.

Core area
See Security Habitat (grizzly bears).

Cover
See HIDING COVER and/or THERMAL COVER.

Coarse down woody material
Dead trees within a forest stand that have fallen and begun decomposing on the forest floor.

Crown cover or crown closure
The percentage of a given area covered by the crowns of trees.

Cull
A tree of such poor quality that it has no merchantable value in terms of the product being cut and manufactured.

Cumulative effect
The impact on the environment that results from the incremental impact of the action when added to other actions. Cumulative impacts can also result from individually minor actions, but collectively they may compound the effect of the actions.

Direct effect
Effects on the environment that occur at the same time and place as the initial cause or action.

Ditch relief
A method of draining water from roads using ditches and a corrugated metal pipe. The pipe is placed just under the road surface.

Dominant tree
Those trees within a forest stand that extend their crowns above surrounding trees and capture sunlight from above and around the crown.

Drain dip
A graded depression built into a road to divert water and prevent soil erosion.

Ecosystem
An interacting system of living organisms and the land and water that make up their environment; the home place of all living things, including humans.

Embeddedness
Embeddedness refers to the degree of armour or the tight consolidation of substrate.

Environmental effects
The impacts or effects of a project on the natural and human environment.

Equivalent clearcut area (ECA)
The total area within a watershed where timber has been harvested, including clearcuts, partial cuts, roads, and burns.

Allowable ECA - The estimated number of acres that can be clearcut before stream-channel stability is affected.

Existing ECA - The number of acres that have been previously harvested taking into account the degree of hydrologic recovery that has occurred due to revegetation.

Remaining ECA -The calculated amount of harvesting that may occur without substantially increasing the risk of causing detrimental effects to stream-channel stability.

Excavator piling
The piling of logging residue (slash) using an excavator.

Fire regimes
Describes the frequency, type, and severity of wildfires. Examples include: frequent, nonlethal underburns; mixed-severity fires; and stand-replacement or lethal burns.

Fluvial
A fish that outmigrates to a river from its natal stream as a juvenile to sexually mature in the river, and returns to its natal stream to spawn.

Foliar nutrients
Nutrients that are contained in the brown or canopy of a tree.

Forage
All browse and nonwoody plants available to wildlife for grazing.

Foreground view
The view immediately adjacent to a road or trail.

Forest improvement (FI)
The establishment and growing of trees after a site has been harvested. Associated activities include:

- site preparation, planting, survival checks, regeneration surveys, and stand thinnings;
- road maintenance;
- resource monitoring;
- noxious weed management; and
- right-of-way acquisition on a State forest.

Fragmentation (forest)
A reduction of connectivity and an increase in sharp stand edges resulting when large contiguous areas of forest with similar age and structural characteristics are interrupted through disturbances, such as stand-replacement fires and timber stand harvesting.

Fragstats
A computer software program designed to compute a wide variety of landscape metrics for categorical map patterns.

Frass
Debris or excrement produced by insects

Geomorphological processes
The observed proportions of habitat types for each reach are within the broad ranges of expected conditions.

Habitat
The place where a plant or animal naturally or normally lives and grows.

Habitat type
Land areas that would produce similar plant communities if left undisturbed for a long period of time.

Harvest units
Areas of timber proposed for harvesting.

Hazard reduction
The abatement of a fire hazard by processing logging residue with methods such as separation, removal, scattering, lopping, crushing, piling and burning, broadcast burning, burying, and chipping.

Hiding cover
Vegetation capable of hiding 90 percent of a standing adult mammal from human view at a distance of 200 feet.

Historical forest condition
The condition of the forest prior to settlement by Europeans.

Indirect effects
Secondary effects that occur in locations other than the initial action or significantly later in time.

Insectivorous
Feeding or subsisting on insects.

Intermediate trees
Characteristics of certain tree species that allow them to survive in relatively low-light conditions, although they may not thrive.

Interdisciplinary team (ID Team)
A team of resource specialists brought together to analyze the effects of a project on the environment.

K factor
The soil erodibility factor which represents both susceptibility of soil to erosion and the rate of runoff, as measured under the standard unit plot condition.

Landscape
An area of land with interacting ecosystems.

McNeil Coring
McNeil coring is a method used to determine the size range of material in streambed spawning sites.

Macroporosity
The gaseous portion of a soil profile typically containing pores on the order of 3 to 100mm in diameter and are nterconnected to varying degrees; thus, they can allow water to bypass the soil matrix and move rapidly to a basal saturated zone and/or move downslope as pipe flow at speeds greater then predicted by Darcy's Law.

Meso-carnivores
Mid-sized carnivore species (e.g. lynx, bobcat, pine marten, wolverine).

Meter
A distance equal to 39.37 inches.

Middleground view
The view that is 200 to 1,000 feet from a road or trail, usually consisting of hillsides and drainages.

Millimeter
A distance equal to .03937 inch.

Mitigation measure
An action or policy designed to reduce or prevent detrimental effects.

Multistoried stands
Timber stands with 2 or more distinct stories.

Nest site area (bald eagle)
The area in which human activity or development may stimulate the abandonment of the breeding area, affect successful completion of the nesting cycle, or reduce productivity. It is either mapped for a specific nest, based on field data, or, if that is impossible, is defined as the area within a ¼-mile radius of all nest sites in the breeding area that have been active within the past 5 years.

No-action alternative
The option of maintaining the status quo and continuing present management activities by not implementing the proposed project.

Nonforested area
A naturally occurring area, (such as a bog, natural meadow, avalanche chute, and alpine areas) where trees do not establish over the long term.

Old growth
Working definition - Old growth as defined by *Green et al*.

Conceptual definition - The term old growth is sometimes used to describe the later, or older, stages of natural development of forest stands. Characteristics associated with old-growth generally include relatively large old trees that contain a wide variation in tree sizes, exhibit some degree of a multi-storied structure, have signs of decadence, such as rot and spike-topped structure, and contain standing large snags and large down logs.

Old-growth network
A collection of timber stands that are selected to meet a management strategy that would retain and recruit 150+-year-old stands over the long term (biodiversity, wildlife, the spatial arrangement of stands and their relationship to landscape patterns and processes) are elements that are considered in the selection of stands.

Overstory
The level of the forest canopy that include the crowns of dominant, codominant, and intermediate trees.

Patch
A discrete (individually distinct) area of forest connected to other discrete forest areas by relatively narrow corridors; an ecosystem element (such as vegetation) that is relatively homogeneous internally, but differs from what surrounds it.

Potential nesting habitat (bald eagle)
Sometimes referred to as 'suitable nesting habitat', areas that have no history of occupancy by breeding bald eagles, but contain potential to do so.

Project file
A public record of the analysis process, including all documents that form the basis for the project analysis. The project file for the White Porcupine Multiple Timber Sale Project DEIS is located at the Swan River State Forest headquarters office at Goat Creek.

Redds
The spawning ground or nest of various fish species.

Regeneration
The replacement of one forest stand by another as a result of natural seeding, sprouting, planting, or other methods.

Reinitiation
The first phase of the process of stand development.

Resident
Pertaining to fish, resides and reproduces in natal stream.

Residual stand
Trees that remain standing following any cutting operation.

Road-construction activities
In general, "road-construction activities" refers to all activities conducted while building new roads, reconstructing existing roads, and obliterating roads. These activities may include any or all of the following:

- constructing road
- clearing right-of-way
- excavating cut/fill material
- installing road surface and ditch drainage features
- installing culverts at stream crossings
- burning right-of-way slash
- hauling and installing borrow material
- blading and shaping road surfaces

Road improvements
Construction projects on an existing road to improve the ease of travel, safety, drainage, and water quality.

Saplings
Trees 1.0 inches to 4.0 inches in dbh.

Sawtimber trees
Trees with a minimum dbh of 9 inches.

Scarification
The mechanized gouging and ripping of surface vegetation and litter to expose mineral soil and enhance the establishment of natural regeneration.

Scoping
The process of determining the extent of the environmental assessment task. Scoping includes public involvement to learn which issues and concerns should be addressed and the depth of the assessment that will be required. It also includes a review of other factors such as laws, policies, actions by other landowners, and jurisdictions of other agencies that may affect the extent of assessment needed.

Security
For wild animals, the freedom from the likelihood of displacement or mortality due to human disturbance or confrontation.

Security habitat (grizzly bears)
An area of a minimum of 2,500 acres that is at least 0.3 miles from trails or roads with motorized travel and high-intensity, nonmotorized use during the nondenning period.

Seedlings
Live trees less than 1.0 inch dbh.

Seedtree harvesting
Removes all trees from a stand except for 6 to 10 seed-bearing trees per acre that are retained to provide a seed source for stand regeneration.

Sediment
Solid material, mineral or organic, that is suspended and transported or deposited in bodies of water.

Sediment yield
The amount of sediment that is carried to streams.

Seral
Refers to a biotic community that is in a developmental, transitional stage in ecological succession.

Shade intolerant
Describes tree species that generally can only reproduce and grow in the open or where the overstory is broken and allows sufficient sunlight to penetrate. Often these are seral species that get replaced by more shade-tolerant species during succession. In Swan River State Forest, shade-intolerant species generally include ponderosa pine, western larch, Douglas-fir, western white pine, and lodgepole pine.

Shade tolerant
Describes tree species that can reproduce and grow under the canopy in poor sunlight conditions. These species replace less shade-tolerant species during succession. In Swan River State Forest, shade-tolerant species generally include subalpine fir, grand fir, Douglas-fir, Engelmann spruce, western hemlock, and western red cedar.

Sight distance
The distance at which 90 percent of an animal is hidden from view by vegetation.

Silviculture
The art and science of managing the establishment, composition, and growth of forests to accomplish specific objectives.

Site Preparation
A hand or mechanized manipulation of a harvested site to enhance the success of regeneration. Treatments are intended to modify the soil, litter, and vegetation to create microclimate conditions conducive to the establishment and growth of desired species.

Slash
Branches, tops, and cull trees left on the ground following harvesting.

Snag
A standing dead tree or the portion of a broken-off tree. Snags may provide feeding and/or nesting sites for wildlife.

Soil wood
Decomposed woody material that is incorporated into a soil profile which can provide habitat for bacteria and fungal communities.

Spur roads
Low-standard roads that are constructed to meet minimum requirements for harvesting-related traffic.

Stand
An aggregation of trees that are sufficiently uniform in composition, age, arrangement, and condition and occupy a specific area that is distinguishable from the adjoining forest.

Stand density
Number of trees per acre.

Stocking
The area of a piece of land that is now covered by trees is compared to what could ideally grow on that same area. The comparison is usually expressed as a percent.

Stream gradient
The slope of a stream along its course, usually expressed in percentage, indicating the amount of drop per 100 feet.

Stumpage
The value of standing trees in the forest. Sometimes used to mean the commercial value of standing trees.

Substrate scoring
Rating of streambed particle sizes.

Succession
The natural series of replacement of one plant (and animal) community by another over time in the absence of disturbance.

Suppressed
The condition of a tree characterized by a low-growth rate and low vigor due to overcrowding competition with overtopping trees.

Texture
A term used in visual assessments indicating distinctive or identifying features of the landscape depending on distance.

Thermal cover
For white-tailed deer, thermal cover has 70 percent or more coniferous canopy closure at least 20 feet above the ground, generally requiring trees to be 40 feet or taller. For elk and mule deer, thermal cover has 50 percent or more coniferous canopy closure at least 20 feet above the ground, generally requiring trees to be 40 feet or taller.

Timber-harvesting activities
In general, all the activities conducted to facilitate timber removal before, during, and after the timber is removed. These activities may include any or all of the following:

- felling standing trees and bucking them into logs
- skidding logs to a landing
- processing, sorting, and loading logs at the landing
- hauling logs to a mill
- slashing and sanitizing residual vegetation damaged during logging
- machine piling logging slash
- burning logging slash
- scarifying, preparing the site as a seedbed
- planting trees

Understory
The trees and other woody species growing under a, more-or-less, continuous cover of branches and foliage formed collectively by the overstory of adjacent trees and other woody growth.

Uneven-aged stand
Various ages and sizes of trees growing together on a uniform site.

Ungulates
Hoofed mammals, such as mule deer, white-tailed deer, elk, and moose, that are mostly herbivorous and many are horned or antlered.

Vigor
The degree of health and growth of a tree or stand.

Visual screening
The vegetation that obscures or reduces the length of view of an animal.

Watershed
The region or area drained by a river or other body of water.

Water yield
The average annual runoff for a particular watershed expressed in acre-feet.

Water-yield increase
An increase in average annual runoff over natural conditions due to forest canopy removal.

ACRONYMS

ARM	Administrative Rules of Montana
BMP	Best Management Practices
dbh	diameter at breast height
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality
DFWP	Montana Department of Fish, Wildlife, and Parks
DNRC	Department of Natural Resources and Conservation
ECA	Equivalent Clearcut Acres
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FI	Forest Improvement
FNF	Flathead National Forest
FY	Fiscal Year (July 1 – June 30)
FOGI	Full Old-Growth Index
GIS	Geographic Information System
ID Team	Interdisciplinary Team
MCA	Montana Codes Annotated
MEPA	Montana Environmental Protection Act
MBF	Thousand Board Feet
MMBF	Million Board Feet
MNHP	Montana Natural Heritage Program
NWLO	Northwestern Land Office
RMZ	Riparian Management Zone
ROD	Record of Decision
SFLMP	State Forest Land Management Plan
SLI	Stand-level Inventory
SMZ	Streamside Management Zone
SVGBCA	Swan Valley Grizzly Bear Conservation Agreement
TMDL	Total Maximum Daily Load
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

124 Permit	Stream Preservation Act Permit
3A Authorization	A short-term Exemption from Montana's Surface Water Quality and Fisheries Cooperative Program
Forest Management Rules	Administrative Rules for Forest Management
Land Board	Board of Land Commissioners
Plum Creek	Plum Creek Timber Company

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